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## Editorial

### EPIPHYSEAL SLIPPING OF THE HIP

THERE is scarcely a chapter in the history of orthopedic surgery which more clearly records the change and development of this specialty which has come about within the period of a generation than that of the conception of pathogenesis and treatment of this condition.

The more or less general mechanical concept of treatment of deformity and locomotor disability arising from a wide diversity of etiological factors has been supplemented, and perhaps here and there, somewhat superceded, by diligent inquiry into questions of causation and prevention of the conditions which come within the sphere of activity of the orthopedic surgeon. All this has led to a re-examination of the essential pathological condition with which he is dealing in the material that lies at his hand.

It used to be said that an orthopedic patient is a patient for the "duration," meaning thereby, the rest of that patient's life. This statement, like the report of Mark Twain's death when it was read to him, is, as he expressed it, "somewhat exaggerated." Nevertheless one may conclude that the orthopedic surgeon has from the first been interested in a sequence of pathological changes which sometimes implies a considerable period of observation.

In this category used to fall epiphyseal separation of the hip. The adolescent who presented the clinical picture of a minor or major alteration of relationship between

the capital epiphysis of the femur and its parent bone was very often destined to be an adult "hip cripple."

The early attempts at treatment were concerned entirely with a re-approximation of the altered parts. This involved at first, traction, later, forcible manipulation, and still later, open operation to restore contour.

With the exception of traction (which determined rest in bed), it is exceedingly likely that the early alternatives of therapy mentioned above frequently did harm rather than good. The basis in pathological anatomy for the observation is that any method of procedure which would have for its end a restoration of contour might easily compromise the blood supply of the capital epiphysis and lead to aseptic necrosis with ultimate osteo-arthritis of the hip.

What should be the answer to the problem? We know that certain adolescents, frequently of the overweight "endocrine" class, present a softening of structure at the epiphyseal junction. We do not know its cause. We know that under the influence of minor trauma, or by the operation of ordinary wear and tear, the epiphysis will slip and thus produce the symptoms of hip joint disability. We do not know, nor have we any rules to guide us as to just which ones are going to stop slipping some more, or which ones are going to proceed to union without further displacement. But we do know that we can circumvent the

process by assuring a somewhat earlier union of the epiphysis with the parent bone than nature might ordinarily have designed.

The method which should be employed to "implement" this desirable consequence has not been too clearly defined. The alternatives which present may be summarized as follows:

- i. Leave it alone and "take a chance."
- ii. Put the patient to bed during the painful period, hang a weight on his leg and "take a chance."
- iii. Do a forcible manipulation under anesthesia designed to reduce a displacement, with subsequent rest in plaster of Paris. This is a two-edged sword; the displacement may occasionally be reduced, yet what follows too often is necrosis of the epiphysis and arthritis of the hip.
- iv. Do an open operation to reduce the dislocation. This is little better than No. iii.
- v. Do an operation designed to secure a premature union between epiphysis and neck. Simple bone drilling across the epiphyseal line has been advocated for this purpose. Such an operation may from time to time accomplish its design, but offers no assurance that a further degree of displacement may not occur during the "waiting period."
- vi. Open reduction with fixation by the Smith-Petersen nail. This is no better than No. iii.
- vii. Open reduction with fixation by autogenous bone graft. This also involves the hazard of aseptic necrosis of the head.

viii. Internal fixation of the parts in the position present at the time of observation and without opening the hip joint unless the displacement is extreme. Such a procedure preserves whatever blood supply is left to the upper femoral epiphysis. Nails or wires may be used as internal fixation agents. An autogenous bone graft may well add something more in that it supplies not only a sufficient period of fixation, but also the osteogenic capacity to secure an early union of head and neck.

ix. Subtrochanteric osteotomy. If union is attained in a position of much deformity, osteotomy may be employed to "roll" into the hip joint a spherical head by suitably gaging the osteotomy attitude to this purpose.

Statistical data bearing on the results of the employment of these various alternatives must always be open to the criticism that, in the first place, there is a relative infrequency of these cases, and in the second place, the failure of the observer to take into account the multiplicity of the factors involved. A single case means nothing, nor do a few.

The only meaning in all this is that we should all examine this problem more carefully in the light not only of the mechanical aspects of the condition of "epiphyseal separation of the hip" but also in the light of its essential pathological changes, and thereby arrive at a substantial improvement in the management and outcome of these cases.

ARTHUR KRIDA, M.D.



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# Original Articles

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## RUPTURE OF THE INTERVERTEBRAL DISC\*

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THE causes of back pain ramify into every field of medicine. Many attempts have been made to present the condition in panoramic perspective. Now, instead, the study of individual situations has come into vogue with the ultimate hope of molding the fragments together and thus solving the problem. We shall limit ourselves to the study of a cause of back pain, and probably the most common, that due to pathological disturbances referable to the intervertebral disc. This study is the result of a critical examination of the literature together with a review of 250 consecutive surgically treated patients.

### TERMINOLOGY

The terminology used in describing the pathological changes of the intervertebral disc is more than a bit confusing. Articles in the literature refer to the condition as "rupture of the intervertebral disc," "protrusion of the intervertebral disc," "retropulsion of the intervertebral disc," "herniation of the intervertebral disc," "herniation of the nucleus pulposus," and "extrusion of the nucleus pulposus." We shall use rupture of the intervertebral disc as an all-inclusive term, and consider the condition in the light of two situations: One, a compression upon the spinal cord and/or nerve roots

brought about by the coursing of the entire disc posteriorly or by weakness of the annulus fibrosus permitting the posterior portion of the disc to bulge without rupture of the contents. This we term protrusion. (Fig. 1.) Horwitz<sup>8</sup> has called attention to the factor in the study of seventy-five adult spines. The second situation, brought into existence also by weakness of the annulus fibrosus, is one in which there is actual rupture through the weakened site in the limiting annulus fibrosus. We shall consider such as herniation. (Fig. 2.)

### ANATOMY

In considering the anatomy of the intervertebral disc, we may, for practical purposes, consider it as a cushion conforming to the contour of the vertebral bodies, inclosed between the superior and the inferior hyaline cartilage plates and surrounded by a ring of fibrocartilage, the annulus fibrosus. Contained within the disc, much like the liquid center of a golf ball, is the nucleus pulposus which adds elasticity to the disc. It is this structure which produces the tendency to horizontal rupture when the limiting annulus fibrosus is weak. Since the annulus fibrosus is thicker and stronger anteriorly and thin and weak posteriorly, an anatomic reason for rupture exists.

\* From the Services of Dr. R. Eustace Semmes, Department of Neurological Surgery, and Dr. J. S. Speed, Department of Orthopedic Surgery, The University of Tennessee School of Medicine, The Baptist Memorial Hospital and The Willis C. Campbell Clinic, Memphis, Tennessee.

## PHYSIOLOGY

Physiologically, the influencing factor in either protrusion or herniation is the nucleus pulposus. This structure is responsi-

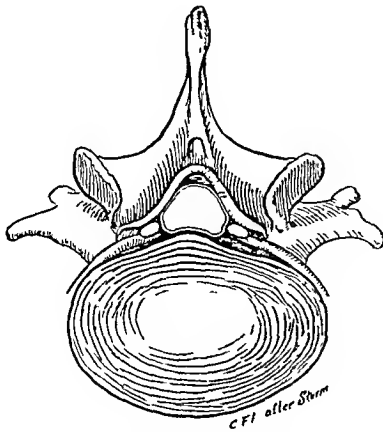


FIG. 1. Protrusion of the intervertebral disc.

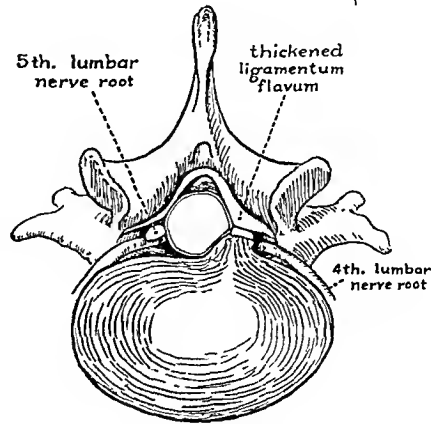


FIG. 2. Herniation of the intervertebral disc.

ble for the expansibility of the disc. It is the nucleus pulposus, rather than the inert cartilage of the disc, which absorbs the brunt of the shocks of the ordinary wear and tear of life and which exerts a cushioning effect. It is this same structure which reacts to force in much the same manner as does the liquid center of a golf ball on being struck. Its spheroid character is flattened, but it expands concentrically at the expense of the annulus fibrosus. Keyes and Compere,<sup>10</sup> in their conclusive study of the function of the nucleus pulposus of the intervertebral disc, point out that the confined and compressed nucleus pulposus depends for its status quo upon the integrity of its limiting structures, the cartilage plates above and below and the surrounding annulus fibrosus. Compression of the spinal cord and/or nerve roots is brought about when weakening of the annulus fibrosus permits encroachment upon them.

The expansibility of the disc is questioned by some. Bradford<sup>1</sup> considers the disc as a plastic rather than an expansile body. Petter,<sup>13</sup> however, in an elaborate experiment, demonstrated the expansibility of the disc by virtue of its contained nucleus pulposus and showed that a rather

tremendous force (thirty-two pounds) is required to compress or flatten the expanded nucleus. That the disc expands when the limiting structures are pathologi-

cal is demonstrated in cases of extreme osteoporosis. (Fig. 3.)

## ETIOLOGY

In discussing the etiology of rupture of the intervertebral disc, weakness of the annulus fibrosus is the predisposing cause. Trauma is the precipitating factor in most instances.

We have seen that the annulus fibrosus is anatomically weak in its posterior portion. Two theories are advanced to account for weakness of the annulus fibrosus: (1) that of ischemia or loss of blood supply in adolescence, as advanced by Bradford,<sup>1</sup> and (2) that of dehydration to which Keyes and Compere<sup>10</sup> adhere. Since adequate proof is still lacking, we must continue to regard such reasoning as purely theoretical.

Another factor to be considered in the production of symptoms is calcification of the entire disc. In rare instances, actual ossification, as pointed out by Horwitz,<sup>8</sup> may be seen. This may be a natural sequel to dehydration. In any event, whether the disc is calcified or ossified, the once elastic disc is transformed into a rigid structure. We believe that calcification follows rather than precedes rupture. The initial symptoms, having been mild, may have been

overlooked by the patient, but later on, through mechanical derangement, the entire disc may move posteriorly sufficient to

be overlooked that repeated minimal traumatic shocks have a place in the etiology of these cases, an observation

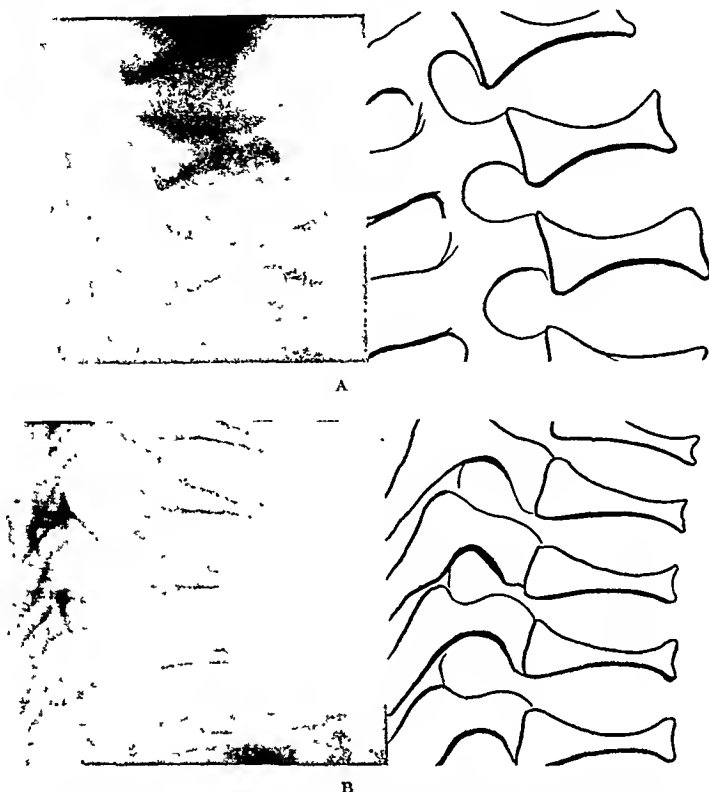


FIG. 3. Illustrates the expansibility of the intervertebral disc in pathological conditions (osteoporosis) of the vertebral column. (A) Lumbar region; (B) dorsal region.

provoke more severe symptoms. We shall see in Case II an instance of calcification of an intervertebral disc.

The predisposing factor, anatomical weakness, may exist in many individuals without rupture ever taking place. Where the predisposing factor is present, trauma is the precipitating factor. Trauma may be relatively mild or it may be more violent and severe; most often, it is sudden. Commonest causes of severe trauma are falls from a height and involvement in automobile accidents in which there may or may not be accompanying compression fractures of the vertebrae. Included among the milder forms of trauma are the lifting of weights, the manipulation of the spine under anesthesia, and sudden jerky movements, as in the cervical region. While trauma is ordinarily sudden, it is not to

made by Schmorl and Junghanns<sup>16</sup> in 1932, and later supported by Donohue.<sup>5</sup> In our series, the lifting of moderately heavy weights and sudden movements of the head figured most prominently in the patient's history.

#### MECHANISM

Rupture of the intervertebral disc occurs with the spine in a position of flexion. Of course, the predisposing factors must exist and the precipitating factor, trauma, must come into being. Flexion narrows the intervertebral space anteriorly and widens the space posteriorly. The anterior portions of the bodies more closely approximate each other, whereas the spinous processes and posterior portions of the bodies become separated. Upon the occasion of trauma, as in the lifting of a heavy weight,

the compression force tending to displace the disc posteriorly becomes excessive and protrusion or herniation results. (Fig. 4.)

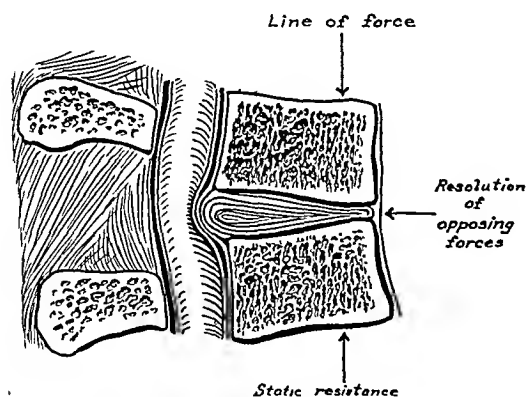


FIG. 4. Illustrates the mechanism responsible for rupture of the intervertebral disc. Compression force from above includes the superincumbent weight plus the added strain of the weight lifted. The static resistance is the stabilizing force which opposes the force from above. These vertical forces resolve themselves in the horizontal force directed posteriorly which, in the presence of the predisposing and precipitating factors, accounts for rupture.

Since the fulcrum of motion of the vertebral bodies is close to the anterior vertebral margin in flexion, a small compression force anteriorly produces a proportionately greater force posteriorly as the result of its superior advantage in leverage.

In the case of protrusion, the posterior portion of the disc is so compressed against the weakened annulus fibrosus as to cause bulging without actual rupture. Where the bulging is sufficient, encroachment upon the cord and/or nerve roots results. Protrusion may be seen in the instance of the calcified disc. We believe that protrusion precedes calcification. Mechanically, it is more difficult for a rigid body to become compressed and dislodged.

In the case of herniation, the same mechanical forces exist. The same compression factor comes in for consideration; but the weakened annulus fibrosus ruptures instead of ballooning out while maintaining its stretched weakened fibers intact. Herniation occurs through the weakest portion of this heretofore limiting structure.

## SITE OF RUPTURE

The material investigated and the symptom-complex have been, in the main, relative to rupture of the lumbar intervertebral discs. In our series, rupture occurred in 243 cases (97.2 per cent) in the lumbar region, in the cervical region in five cases (2 per cent), and in the thoracic region in two cases (0.8 per cent) reported in this paper. Five cases (2 per cent) showed evidence of rupture at two or more levels. These percentages, however, do not coincide with the percentages on the average found in the literature. We believe that, on the whole, rupture in the lumbar region is less than 97 per cent, that it is greater than 2 per cent in the cervical region, though admittedly the number of cases reported in the thoracic region is meagre.

Rupture occurs most commonly in the regions of greatest lordosis. As observed by Semmes and Murphey,<sup>18</sup> this has an anatomical reason, the horizontal diameter of the intervertebral foramina being least at points of maximum lordosis as the result of the "anterior thrust of the articular facets." In the lumbar region, rupture is most common at the fourth interspace and at the lumbosacral articulation; in the thoracic region, from the ninth interspace to the lumbodorsal junction; and in the cervical region, from the fifth interspace to the cervicodorsal junction.

Rupture usually occurs posterolaterally with ensuing compression of the nerve root emanating at or just above that point. Less commonly, it may occur centrally with symptoms of partial cord compression in the more severe cases, but with only moderate soreness in the milder cases. At some time following central rupture, however, the protruding material may migrate laterally with ensuing typical nerve root symptoms. We have seen cases in which the rupture previously localized on one side has migrated to the opposite side. Stookey<sup>23</sup> distinguished three types of compression, namely, bilateral cord compression, uni-

lateral cord compression and compression of the nerve root. (Fig. 5.)

#### SYMPTOMATOLOGY

We will consider the symptomatology according to anatomical division since the symptoms vary with the region.

shortly afterward or not until several months later. The patient will complain of pain in the posterior aspect of the thigh in the case of rupture at the fourth or fifth interspace, whereas rupture at the third interspace produces pain in the medial aspect of the leg. He will also experi-

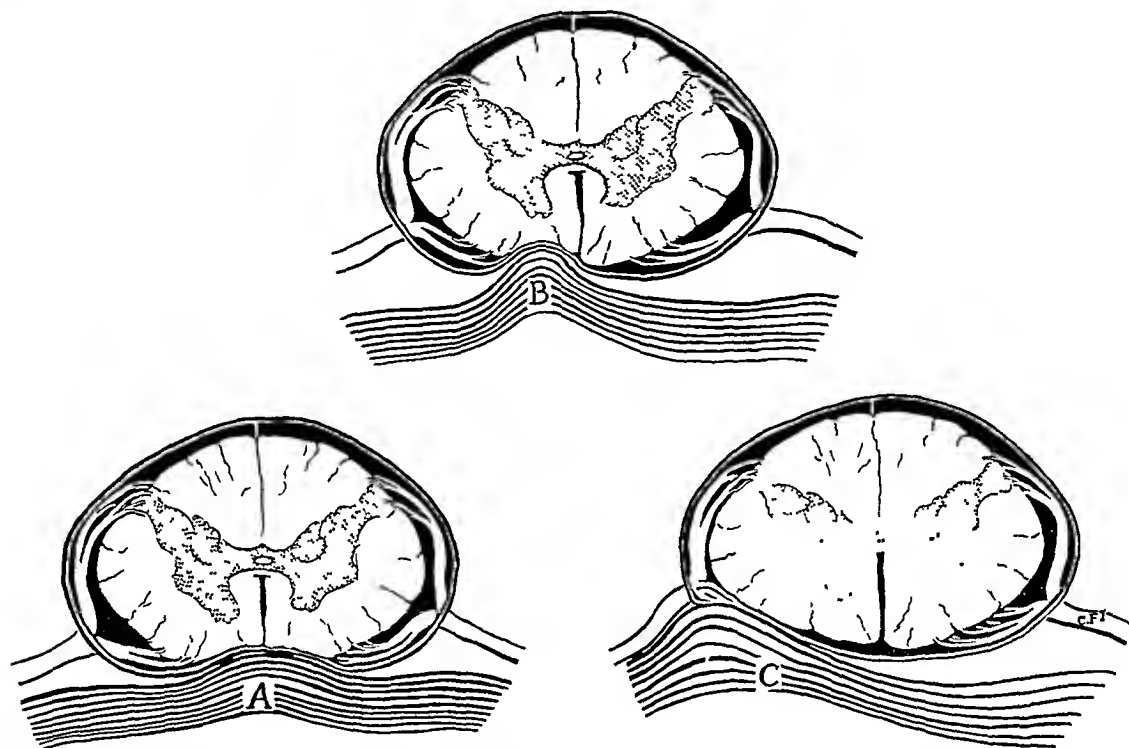


FIG. 5. Demonstrates the different manners in which protrusion or herniation compress the spinal cord and nerve roots. (A) Bilateral cord compression; (B) unilateral cord compression; (C) nerve root compression. (Modified after Stookey. *Arch. Neurol. & Psychiat.*, 1928.)

Because of its frequency, the symptomatology of rupture of the intervertebral disc in the lumbar region is best known. The history, of course, is significant. Pain in the lower back usually comes on suddenly following strain in flexion. Subjectively, the patient may only experience soreness or a "catch" in the lower back, or the pain may be severe and incapacitating at the onset. The back pain is the reaction to trauma on the part of the intervertebral disc and the posterior longitudinal ligament. The studies of Roofe<sup>15</sup> demonstrated that these structures are innervated by recurrent branches of the lumbar plexus. Radiation of pain into sciatic distribution may occur at the time,

ence difficulty in stooping to tie his shoes. Pain on anterior bending will verify such for the examiner. A positive straight leg raising or Laseque sign on the affected side affords further verification. This is one of the most reliable tests. There are often sensory changes in the fourth and fifth lumbar and first and second sacral distribution. These may be in the form of paresthesias or hypesthesias. The patient may complain of tingling or pricking sensations. Often he will observe the sensation of numbness or coldness coinciding with the cutaneous distribution. Areas of hypesthesia in the lower extremity may, in some instances, be mapped out by the examiner. He may notice pain at the site of rupture on

coughing, sneezing or straining at stool, or, the back pain may be unaffected with an exacerbation of the radiating pain. Jugular

consistency. Examination of the back usually reveals a moderate to marked degree of muscle spasm, more pronounced on the

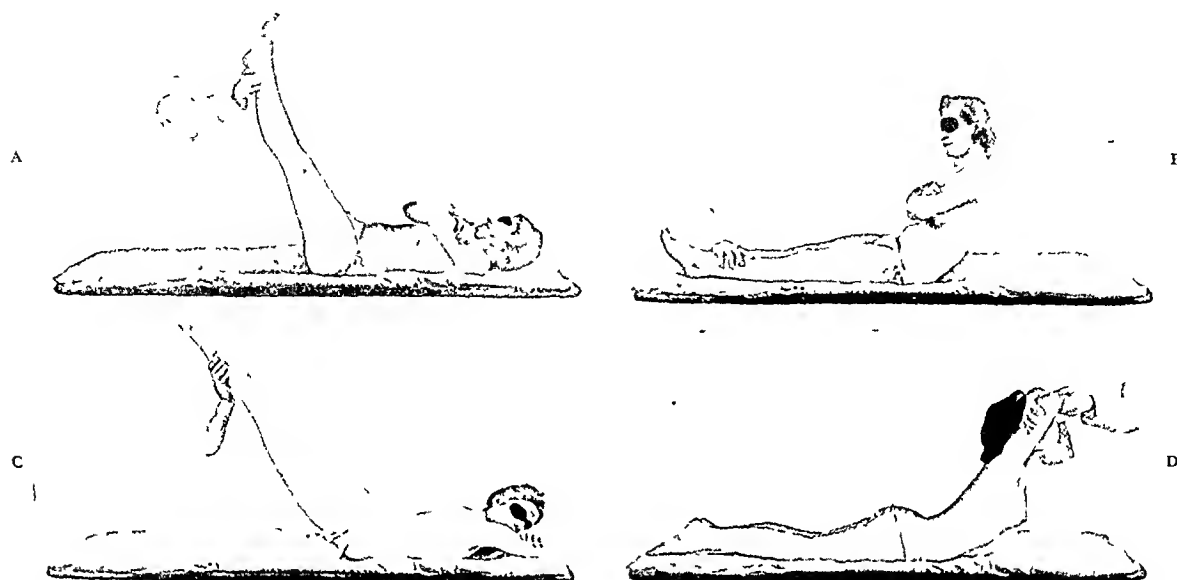


FIG. 6. Demonstrates the suggested method of differentiating rupture at the sacrolumbar articulation from that of the fourth interspace. (A) Upper left; (B) upper right; (C) lower left; (D) lower right. It will be noted that (A), (B) and (C) are active motions on the part of the patient; (D) is passive and performed by the examiner. When positive, pain referred to sacrolumbar articulation.

compression, after the fashion of Viets<sup>25</sup> and Naffziger,<sup>12</sup> will often localize and reproduce the pain. The patient's tailor or seamstress may be the first to call his attention to scoliosis, usually away from the site of the lesion, by observing that one shoulder "droops," or that the shoulder girdle is not in complete alignment with the pelvis. The ilium is often higher on the affected side. The patient may limp, thus favoring the painful limb. The knee jerk is usually unaffected, though it may be diminished. The ankle jerk may be unaffected, but ordinarily is diminished or absent. Spurling and Grantham<sup>21,22</sup> and Spurling and Bradford<sup>20</sup> believe that diminution or absence of the knee jerk is indicative of rupture at the third interspace, non-involvement of the knee jerk and ankle jerk demonstrative of rupture at the fourth interspace, and diminution or absence of the ankle jerk is evidence of rupture at the lumbosacral articulation. In our series, we have not been able to verify these findings with any degree of

unaffected side in standing, and usually disappearing in a sitting or relaxed position. There is often flattening of the normal lumbar curvature. Measurement of the lower extremities will reveal atrophy in cases of long standing. Palpation, at best, is inaccurate and faulty. While pain is chiefly reflected in the region of the fourth and fifth interspace, many of these patients complain of tenderness in the region of the ischial tuberosity. This may be explained by the relative superficiality of the sciatic nerve as it passes through the greater sciatic notch. Another point of superficiality and also of pain is at the popliteal space.

A suggested method of differentiating rupture at the sacrolumbar articulation from that of the fourth interspace consists in hyperflexion and hyperextension of the extended lower limbs upon the trunk. This results in pain at the sacrolumbar articulation in the case of rupture at this interspace. Hyperextension and hyperflexion of the trunk on the lower limbs will produce the same symptom. True, patients

with anomalies in the sacrolumbar region or with relatively stable fifth interspace may complain of an exacerbation at the

inaugural phase came on suddenly with sensation of pain, moderate to severe, originating in the cervical region and re-



FIG. 7. Case 11. Calcified disc is best seen in lateral view.

fourth interspace upon these maneuvers, but the test is not designed as an absolute finding. It is merely used as a substantiation of the nearly completed diagnosis. The only active maneuver, from the patient's standpoint, is hyperflexion of the trunk upon the lower extremities; all of the remaining maneuvers are passive and performed by the examiner. (Fig. 6.)

The cervical region is the next most common site of rupture. Horwitz<sup>9</sup> in studying fifty male cadavers noted degeneration, narrowing and ossification in 76 per cent of the specimens. Changes were most common in the fourth, fifth and sixth interspace, but a pathological condition was not to be wholly excluded in the third and seventh cervical and fifth thoracic interspaces. We have recently seen five cases of ruptured intervertebral disc in the cervical region.<sup>18</sup> In all of these, the mechanism has been exactly the same, though the symptomatology necessarily varies.

The situation is initiated by sudden or jerky movements of the head, resulting in a "crick" in the neck. Stookey,<sup>23</sup> an early observer in the case of rupture in the cervical region reporting seven cases since determined to be ruptured discs, believes that the condition usually comes on gradually in this area. In three of the five cases (60 per cent) we have seen, however, the

established by movement of the head, especially if motion be sudden or of rather violent nature. "Electric shocks" radiating down an upper extremity may follow motion.

Adhering to the classification of Stookey,<sup>23</sup> in the case of cord compression the patient may notice pain, coldness or numbness in one or both lower extremities. There may be pain in both shoulders. A painful spot between the scapulae, tender to palpation, may be present. The patient may be stricken with weakness and difficulty in walking. A spastic condition of both lower extremities may ensue in rare instances. In the case of rupture at one of the higher cervical levels, spasticity may involve all four extremities or combinations of them. Loss of bowel or bladder control is not usual. These findings are more common when there is direct protrusion rather than herniation.

In the instance of combined partial cord and unilateral root compression, the patient will demonstrate the signs of compression in a milder degree plus those of actual nerve root compression.

When the nerve root is impinged, root pain usually follows the course of the sixth, seventh and eighth cervical and first thoracic segments. Pain may exist in one shoulder, in the arm, forearm and hand, and even laterally down the thoracic cage.

This is usually more pronounced in certain areas, especially those in which the peripheral nerve is most superficial, as at the elbow and over the dorsum of the forearm in the midportion. There is often definite precordial distress which, combined with radicular pain down the left arm, may simulate angina pectoris or coronary occlusion. Recently, we operated upon a patient and found a typical ruptured disc (sixth cervical) in which the patient had been treated three weeks previously for coronary occlusion. The electrocardiogram taken at the time of said treatment was not significant. Repetition immediately following operation revealed no changes in any of the leads. There may be muscular weakness and atrophy in the upper extremities, shoulder girdle, neck and precordium. There may be involvement of the muscles of the forearm and hand. Stookey<sup>24</sup> reports a case in which there was atrophy of the intrinsic muscles of the hand.

In all cases, there is usually a marked degree of muscle spasm in the cervical region, the patient often holds the head in a rather rigid position, an involuntary effort to splint the part, relieving active and preventing potential pain.

Later, the patient may experience sensory changes. In the instance of cord compression, disturbance in pain and temperature sensation and diminution of tactile sense. Impairment of vibratory sense may be noted. When the compression is unilateral or upon the nerve root, burning and tingling in the shoulder and upper extremity are most common. Numbness may occur in the hand or forearm with areas of hypesthesia.

In cases of some duration, there is scoliotic deviation of the head from the midline, away from the lesion, an involuntary effort to lessen pain. Flattening of the normal curvature or loss of lordosis is common. The pain may be reproduced by motion of the head, especially rotation from the affected side. Palpation of the area may reveal tenderness, but this does not serve to localize the lesion. Coughing,

sneezing and jugular compression will re-enact the pain.

The reflex changes include, in the case of cord compression, diminution of the abdominal reflexes, hyperactivity of the tendon reflexes in the lowers with patellar and ankle clonus and positive Babinski sign. If the rupture be high in the cervical region, the reflexes in the uppers will also be hyperactive. In the case of partial cord compression, changes will be present to a lesser degree and may be more pronounced on one side than on the other. With root compression, tendon reflexes in the lowers are unchanged and in the uppers are often normal.

Rupture of the intervertebral disc is least common in the thoracic region. Schmorl,<sup>16</sup> in an exhaustive study of pathological material, discovered only three instances of rupture in the thoracic region. von Pechy<sup>26</sup> reported one case in 1929, Elsberg<sup>6</sup> one in 1931. Since then there have been scattered reports of cases in the literature.

In our series, thoracic rupture has been seen in only two instances (0.8 per cent), one occurring at the ninth and the other at the eleventh thoracic interspace. Rupture in this region is brought about by a combination of the contributing factors in cervical and lumbar rupture. Sudden violent movements of the head or the strain of lifting moderately heavy objects with the spinal column in a flexed position are notable. The back pain is localized in the thoracic region and is not relieved by the ordinary measures. Accompanying the pain in the back (in the case of protrusion) is a transient spastic paralysis involving one or both lower extremities. Later, only weakness and difficulty in walking persist.

Following the initial attack, there may be periods when the patient is entirely or nearly symptom free, only to have pain recur with the re-establishment of the inaugural conditions. The attacks may be spaced over a period of days, months or years until finally the patient must yield to the severity of the condition. Laughing, yawning, taking a deep breath, coughing,

sneezing or straining at stool are among things which will reproduce pain. Extremes of motion (extension, flexion, rotation or lateral bending), particularly if these be sudden, will initiate the pain.

In the case of cord compression, there may be "electric shocks" down one or both lower extremities. In the instance of nerve root compression, radiation follows along the course of both the anterior and posterior divisions of the spinal nerves originating in the thoracic region. Posterior radiation, of course, results in additional pain in the thoracodorsal area. Radiation along the anterior divisions follows the course of the thoracic segments, resulting in girdle sensation around the chest or upper abdomen. Such may closely simulate pleurodynia, cholecystitis, cholelithiasis and ruptured peptic ulcer. Radiation in the lower extremities and along the thoracic segments may occur in the instance of unilateral cord and nerve root compression.

Muscle spasm is less easily detectible in the thoracic region. Scoliosis may be present, but is less marked than in the lumbar or cervical regions. Flattening or loss of lordosis is discernible in chronic cases.

Sensory changes, in the case of cord compression, include disturbances in pain and temperature sensation, with diminution or impairment of tactile or vibratory sense. The patient will often complain of numbness at the onset, and areas of hypesthesia may be mapped out in certain instances. In nerve root compression there may be burning, numbness or hypesthesia along the course of the thoracic nerve segments involved.

Palpation will not elicit the site of rupture. Jugular compression will grossly reveal the location in most instances. When the test is negative, coughing may cause an exacerbation of pain.

The tendon reflexes are usually hyperactive and accompanied by a positive Babinski sign in the instance of cord involvement. Patellar and ankle clonus may be elicited. The abdominal reflexes are often diminished.

We include two cases in the thoracic region in this paper because of their relative rarity and in the hope that with sufficient case reports and a correlation of the facts and findings, we will grope less in ignorance.

#### CASE REPORTS

CASE I. J. L., a white male, aged thirty-five, a funeral director, was admitted November 20, 1940, with the history that ten days previously while lifting a corpse he experienced severe pain in his back, thighs and legs, accompanied by a complete paralysis of the lower extremities lasting a few minutes, followed by a partial paralysis and numbness of the lower extremities continuing about twelve hours. He regained the use of his limbs, walking with a limp, but the pain continued to be so severe that at times he was completely incapacitated. The pain, which radiated down the front of the thighs and legs, was aggravated by coughing, sneezing and taking a deep breath. Movement re-established the pain. Examination revealed hypesthesia of the anterior aspect of the left thigh and the left leg. Jugular compression reproduced pain in the lower lumbar region; release resulted in pain radiating down the anterior aspect of the left lower extremity. Laseque sign was bilaterally negative. There were no changes in the reflexes. X-rays showed narrowing of the eleventh thoracic interspace. Spinal fluid examination showed the spinal canal to be partially blocked. The total protein was 150 mg.

At operation two days later, protrusion of the eleventh thoracic intervertebral disc was found through hemilaminectomy. Laminectomy was then performed through the eleventh and twelfth thoracic vertebrae and the disc exposed. The disc was found to be somewhat calcified, firmly fixed, and it was decided not to remove it. Thorough decompression of the cord and nerve roots was done by removing a considerable part of the articular facets as well as the laminae.

The patient had considerable lower thoracic and left lower extremity pain for three days postoperatively, but on and since discharge has been free of symptoms.

CASE II. C. H., a white male, aged forty-six, railroad conductor, was admitted November 15, 1938, with the following history: Twelve years previously, while riding the caboose in

semireclining position, the patient was thrown into a position of flexion when the train stopped suddenly. Consciousness was momentarily lost. Upon regaining consciousness, the patient became aware of excruciating pain in the back and it was necessary to remove him from the train on a stretcher. The patient was strongly opposed to medical treatment, however, and a physician was not called until the following day. No symptoms other than backache existed at the time. A year later, the patient noticed sharp pain radiating from the spinal column anteriorly in girdle fashion along the belt line at approximately the level of the umbilicus. Pain in the back persisted but to a lesser degree. Three years later the patient observed numbness in the large toes, which gradually progressed upward to involve both limbs. Some time later the patient found it difficult to bend over to wash his face, and had pain in stooping to tie his shoes. During all of this time, girdle pain persisted, being more pronounced on the left side. In 1933, the patient visited a regularly recognized group who made the diagnosis of "irritable colon." Treatment was prescribed, but no relief obtained. Nine years later the patient observed the sensation of pins and needles in the plantar areas of both feet and began to drag the left lower extremity. Hyperextension of the spine increased the paresthesia. Consultation with regular and cultist physicians brought no relief.

On admission, the patient had no pain on coughing or sneezing, but taking a deep breath or attempting to assume the erect posture resulted in pain in the thoracic region of the spine. Radiation of pain at the level of the umbilicus was especially marked on the left. Both lowers were spastic and the gait was ataxic. The Laseque sign bilaterally was positive, more pronounced on the left. The Naffziger sign was negative. Sensory level was at the tenth thoracic and was better on the left; lower abdominal reflexes were absent. Knee jerks were three plus and equal; ankle jerks were one plus and equal. There was an unsustained ankle clonus on the left. The Babinski sign bilaterally was positive. There was absent position and vibratory sense bilaterally. No loss of lumbar lordosis and no scoliosis were present. Spinal puncture revealed nearly complete subarachnoid block, fluid xanthochromic and total protein 152.5 mg. X-ray showed

narrowing of the ninth thoracic interspace with calcification of the intervertebral disc. (Fig. 8.)

At operation, the laminae of the ninth and tenth thoracic vertebrae were removed, the dura opened and a hard mass causing an indentation of the anterior portion of the dura was discovered. The dura and the cord were then retracted to one side and the mass examined extradurally. It filled the entire ninth thoracic interspace, was calcified on the left side and protruded dorsally about one-fourth inch. Rongeurs were used to remove the calcified portion; the remainder of the disc was excised with a curette. The ninth roots were sacrificed. Thorough decompression was accomplished and the protrusion eliminated.

Following the operation there was complete anesthesia from the umbilicus down; bowel and bladder control were lost. The patient was bedridden six months, during which time the sensation gradually returned, along with bowel and bladder control. Crutches and cane were used about three months following leaving his bed, because of difficulty in walking which gradually subsided.

A check-up three years postoperatively revealed the local and radiating pain to have completely disappeared. The patient walked well, though slightly ataxic. There was complete bowel and bladder control. Laseque and Naffziger signs were negative; extension and flexion of the spine and lower extremities were painless. All sensation had returned except in the superficial peroneal on the left, which accounts for some numbness of the lateral dorsal aspect of the foot. Knee jerks were four plus and equal, ankle jerks two plus and equal. Abdominal reflexes were normal. There was evidence of persistent posterior tract involvement inasmuch as there was loss of proprioceptive sensation of the left lower extremity, positive Babinski, Oppenheim, Chaddock and Romberg signs along with a mild ataxia. Unsustained ankle clonus persisted. The patient now pursues a gainful occupation, working as a railway baggageman. He can lift heavy weights, such as trunks and other articles, for the first time in fifteen years.

From the case reports above, it will be seen that calcification of a protruded disc can occur and that a calcified protruded disc can produce symptoms not unlike a noncalcified disc. Calcification, we believe,

occurs following rupture, but may precede the recognition of subjective symptoms on the part of the patient.

#### LABORATORY FINDINGS

The laboratory can be of assistance in the diagnosis of the ruptured intervertebral disc from the viewpoint of substantiation of the nearly complete diagnosis. Spinal puncture will usually produce an exacerbation of pain, especially in the instance of rupture in the lumbar area. The Queckenstedt test may indicate a partial, rarely a complete block. Blockage is more common in the thoracic and cervical regions. Anatomically, this is the expected finding since protrusion or herniation in the more cephalic portions of the spinal canal need be relatively lesser in degree to produce a partial or a complete block. The quantitative examination of the spinal fluid protein usually finds the amount increased. Love and Walsh<sup>11</sup> in a series of 500 cases recently analyzed found elevation in about 60 per cent. We find it somewhat higher, elevation occurring in 68.9 per cent of 250 cases. We believe that a normal or diminished protein does not exclude rupture, but that a positive increase aids in substantiating and verifying the diagnosis.

#### ROENTGENOGRAPHY

Roentgenological examination plays a definite part in the diagnosis of rupture of the intervertebral disc. Its chief use, peculiarly, is in a negative way. It is of little positive value in localizing the site of protrusion or herniation. Attempts to localize the site by means of the roentgen-ray have, both in our hands and in others, proved to be inconsistent and unreliable. Narrowing of the interspace has been considered indicative of the site of rupture, but often the pathological change is not to be found in the narrowed interspace. The only positive findings of consequence are more or less confirmatory, that is, absolute evidence and record of scoliosis and loss of lordosis. We emphasize, however, that the examiner should not neglect to make

roentgenograms, since they serve to differentiate rupture of the intervertebral disc from conditions which most closely ally and simulate it as: tumors of the spinal cord and surrounding osseous tissues; fractures of the vertebrae without rupture of the disc; congenital anomalies; and various arthritic conditions.

#### MYELOGRAPHY

Myelography was originally introduced with lipiodol as the contrast substance. The most recent innovation involves the use of air for purposes of visualization. Excellent results have been reported for contrast myelography. Camp<sup>2</sup> reports 92.3 per cent accuracy with lipiodol studies. More recently, Hampton<sup>7</sup> has demonstrated the pathological status in 93 per cent of his cases. With improved technic, Camp and Addington<sup>3</sup> claim positive diagnosis in 96.8 per cent of 208 cases. Poppen<sup>14</sup> showed 85.7 per cent of 175 cases to be demonstrable with air. It must be distinctly remembered, however, that these results and percentages, accurate and conclusive as they appear to be, are based on positive cases and do not include non-operative cases on the whole or cases of missed diagnosis. Such inclusion would infinitely destroy the advantage they appear to indicate. On the whole, the cases subjected to myelography are the relatively positive cases or those with adequate symptomatology to place them on a more than suspicious basis. Of the thirteen cases in Camp and Addington's<sup>3</sup> series with negative lipiodol myelography, seven (53.8 per cent) were found to have rupture at the lumbosacral articulation. Since rupture occurs most frequently at the fourth and the fifth interspace, these negative findings reflect limitation of the scope of myelography and cast material doubt upon the value of the procedure.

Myelography has its greatest value in cases in which two or more discs are suspected. The proponents of myelography never fail to point out this advantage. Those opposed to myelography are forced

to admit of its usefulness in the instance of multiple discs.

Dandy<sup>4</sup> recently advocated the abandonment of all contrast methods, including air. Since Semmes<sup>17</sup> advocacy of departure from the irritating lipiodol method in 1939, we have made the operative indication on the basis of history, clinical and laboratory findings, exclusive of myelography with confirmation at operation. The success of this rationale emphasizes the conservatism from both the human and economic viewpoints.

We believe cognizant omission of myelography to be justified because: (1) The diagnosis in most instances may be made with an accurate history, adequate clinical observation, and laboratory routine in "border-line" cases; (2) at operation, we explore the space above the suspected level, as well as the one below; (3) we believe lipiodol is irritating, and though hypothetical, we fear possible reactions; (4) in the cervical and thoracic regions, the lesions are smaller and less likely to be demonstrated; (5) there is difficulty in filling the cervical and thoracic canals with contrast media; (6) the lesions may be so far lateral that they are not in contact with the dura and will not be demonstrated.

#### TREATMENT

In the presence of reasonably positive diagnosis and persistence of symptoms despite conservative measures (traction, immobilization, physical therapy), the treatment is clearly operative. Simple decompression by release of the scarred, fibrotic ligamentum flavum will suffice in rare instances. The operative treatment of choice, however, is extradural removal through the interlaminar space without cost to any osseous structure, or, partial hemilaminectomy removing just sufficient of the inferior portion of the lamina above and of the superior portion of the lamina below to provide adequate exposure. Though laminectomy is rarely necessary, it may be indicated in certain instances as in the cases here reported, and

in addition it may be required to remove some of the articular facets. Spinal fusion is not required when little bone has been sacrificed. In some instances, in which the lumbar spine is relatively weak or the fifth interspace is narrowed, anomalous, shows evidence of arthritis predisposed to be painful, or in the presence of prespondylolisthesis, Speed<sup>19</sup> believes that fusion should be done. When there is postoperative pain which is relieved by a brace, it is indicated as a stabilizing factor. Many patients with laminectomy of several vertebrae do well without fusion or support. Why others complain of pain, which is relieved by fusion, is still not adequately answered.

#### SUMMARY

The mechanism of rupture of the intervertebral disc is presented with the symptomatology of the condition in the lumbar, cervical and thoracic regions. An additional test for detection of rupture at the lumbosacral articulation is advocated. Myelography is considered superfluous in single rupture, since the diagnosis can usually be arrived at with an accurate history and careful clinical and laboratory examinations. The operative treatment of choice in the presence of a reasonably certain diagnosis requires the sacrifice of the ligamentum flavum and partial hemilaminectomy. Two cases of rupture in the thoracic region are presented.

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# DIAGNOSIS AND TREATMENT OF PANCREATIC DISEASE

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FIFTY years ago, in 1892, Osler, the keenest medical mind of his time, devoted a scant page in his first edition of "The Principles and Practice of Medicine," to cover the subjects of both acute and chronic pancreatitis. Recently, one of our medical students was able to devote fifty-six full pages to the subject of acute pancreatitis alone, which gives some idea as to the amount of information which has become available in the intervening years.

In Osler's description, he emphasized the state of collapse, the extreme shock met with and the rare recoveries, stating that it was a condition which was uniformly fatal.

It is not without interest, therefore, that we look back over the approximately fifty years which have passed, and compare our knowledge of today with that then existent and observe wherein we may have advanced.

There has always been an aura of mystery surrounding the pancreas. Many great names of medicine are associated with studies of its functions. Claude Bernard, De Graaf, Langerhans, Fitz of appendicitis fame, Pavlov, and more recently Banting and Best are only a few.

Osler described the symptomatology, and under pathology, the fat necrosis of the acute disease. He commented upon the possibility of suppurative pancreatitis and of a gangrenous pancreatitis, and cited thirty-seven cases all told of pancreatic disease. To the subject of chronic pancreatitis he devoted a total of six and one-half lines, based apparently on postmortem observation alone and stated,

"The organ is firmer than normal, the interstitial connective tissue is increased, and there is more or less change in the secreting structures. A special interest has been aroused lately in this affection, as it has frequently been found in diabetes.

There may be marked pigmentary changes; a similar condition has been found in the liver. Degeneration of the glandular elements is present in these cases. The sclerosis may be associated with calculi in the ducts."

Today the accurate diagnosis of subacute and chronic pancreatic disease still presents one of the difficult problems of medicine because of its extreme variance in symptomatology and because of the inadequacy of our ways and means of obtaining more specific knowledge of pancreatic accretion and function.

In spite of this inadequacy, clinical experience has taught us how to manage these cases better. In spite of the fact that cases of acute pancreatic disease are not common, yet we are able to say, not as Osler said fifty years ago that these cases are uniformly fatal, but that a respectable percentage of patients are able to recover from the disease.

As an illustration of the shift in our conception of this disease, it was thought for many years that the highest percentage of cases of acute pancreatitis occurred in men between the ages of forty and fifty years. Recent statistics suggest that acute pancreatitis occurs more frequently in women and in the age limits of between forty-five and sixty years.

Any attempts to classify acute and chronic pancreatic disease into subdivisions according to possible etiology would serve no purpose other than to confuse and becloud the picture. A simple but serviceable classification is as follows:

- I. Acute Pancreatitis
  - (a) Hemorrhagic or necrotic
  - (b) Suppurative or gangrenous
- II. Chronic Pancreatitis
  - (a) Interstitial

Mechanical factors described as playing a part in the production of acute pancreatic disease are all based upon the common mucosa in the region of the ampulla of sufficient degree to cause occlusion of the common bile duct and turn back the nor-

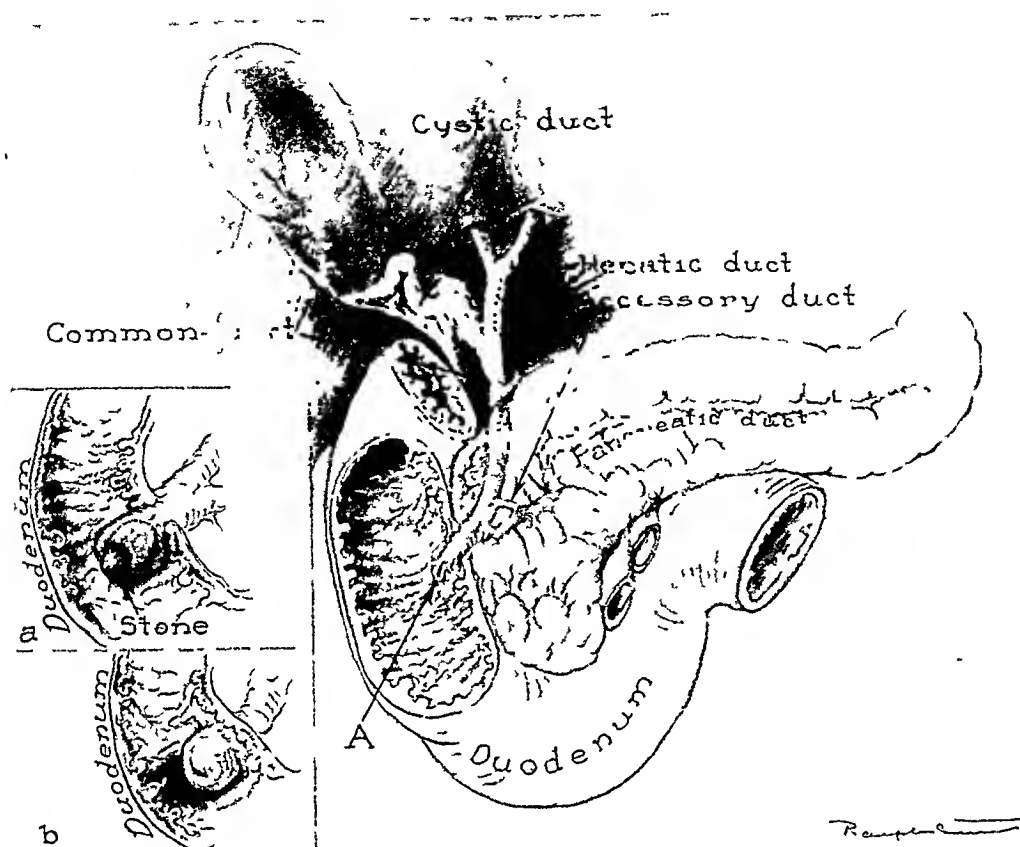


FIG. 1 Normal anatomical relationship of structures involved in production of pancreatitis A, ampulla of Vater, (a) with occlusion by stone, (b) with occlusion in edema

cept that some occlusion takes place in the pancreatic ducts, either the main duct alone, or with the accessory duct, thereby preventing the enzymatic juices from reaching the duodenum and converting the open duct system into a closed one, the enzymes being forced to back up into the pancreas itself and a process of autolysis initiated. Without such an occlusion, reflux of bile along the pancreatic ducts into the pancreas substance has also been described as an etiological factor.

Other physical factors acting to bring about changes in the pancreas might be a gallstone in the duct of Wirsung or in the accessory pancreatic duct, a gallstone at the ampulla of Vater, spasm of the sphincter of Oddi, or edema of the duodenal

mal onward flow of bile at this point, so that the bile backing up the common duct meeting resistance from behind is forced into the pancreatic ducts or duct, then into the substance of the pancreas where, by its irritant action, it produces those changes we associate with pancreatitis. (Fig. 1.)

Attempting to substantiate that a reflux of pancreatic enzyme can also take place in the opposite direction, there was published in 1940 in one of our leading journals some experiences in the study of pancreatic disease along these lines. This author found that in the aspiration of bile from the gallbladder of patients undergoing laparotomies, 17 per cent contained pancreatic ferments, while in acute pancreatitis 88 per cent contained ferments. Such an

observation is not of any significant material value as it has many deficiencies and neither explains or proves anything.

the pancreas. Some experimental data are favorable to the acceptance of this theory. It is well known that in the experimental

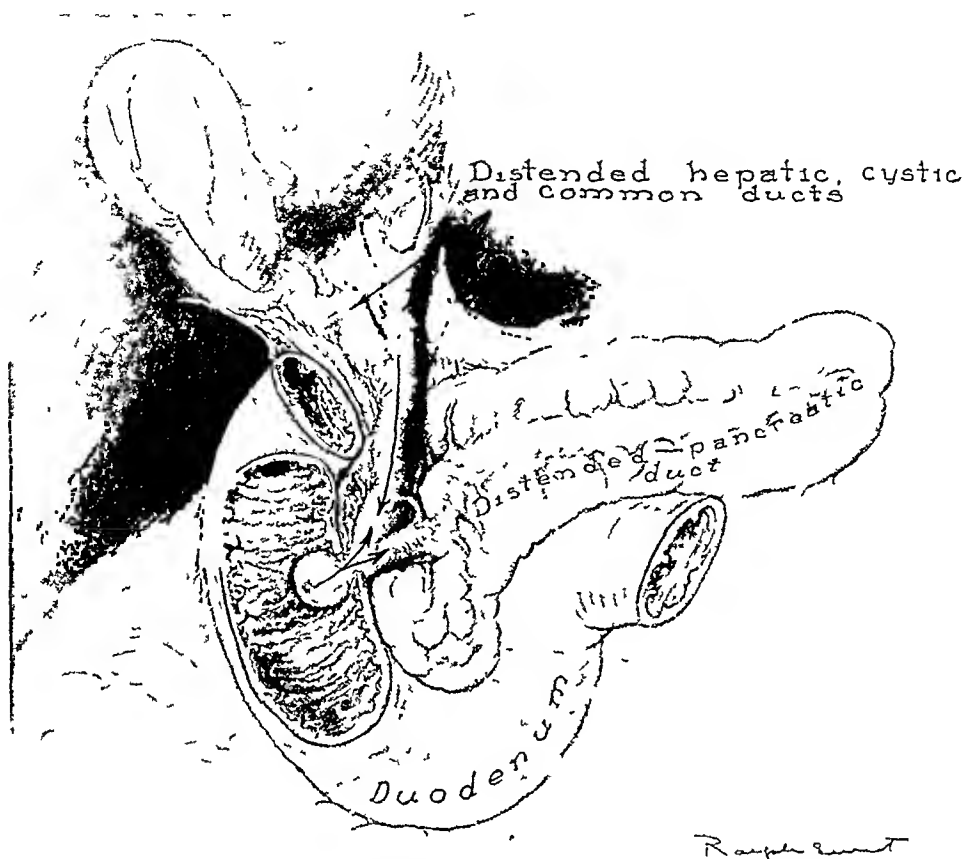


FIG. 2. Mechanics and altered relationship of structures involved in production of pancreatitis, occlusion of ampulla by either stone or edema, reversal of bile flow encountering pressure from above is forced into pancreatic duct system.

Some evidence has accumulated that none of the above changes can account for the production of symptoms inasmuch as it is possible for a common channel mechanism to exist carrying simultaneously both bile and pancreatic enzyme without harm to pancreatic tissue.

Up to the present time, bile has borne the brunt of blame as being the most important single element in the causation of acute pancreatic necrosis. The theory has been that bile getting outside of its normal physiological habitat and getting into a place wherein it is a foreign invader or into a field physiologically unadapted to resist the invader or accommodate itself to its presence, has caused tissue destruction in

animal, injection of bile into the pancreatic ducts causes extensive necrotic destruction of pancreatic tissue. This experiment has been repeated an endless number of times but does not seem to lead anywhere in helping to interpret pancreatic destruction in the living human being.

A multitude of experiments demonstrating the action of trypsin on different types of tissue have been performed to demonstrate this action. Trypsin has been considered by some as an actual malefactor. The liberation of this ferment of highly concentrated digestant action, outside of its normal confines is present in all cases of acute pancreatic necrosis, but what factor changed the controls that it is enabled to

escape outside its normal habitat is not known.

Most poignant of all this speculation is the contention that normal bile backing up from the bile system into the pancreas will not produce pancreatic necrosis, that only infected bile, such as would be found in an acute, subacute or chronic inflammatory process in the gallbladder or duodenum will produce pancreatic change and that such change occurs by way of abnormal secondary trypsin activation.

This possible symbiotic action of bile and trypsin, or infected bile and trypsin together should not be overlooked. It has been demonstrated that the toxic effect of bile can be increased by the presence of a proteolytic agent such as trypsin would be, acting as an advance guard, digesting any mucus or serum proteids which might be in the way of acting as a defending barricade. Such types of substance are known to inhibit the action of bile. Trypsin digestion of such proteids would leave the field clear for a more concentrated and devastating action of bile.

Evidence has been produced to explain the frequent association of gallbladder disease with pancreatitis on the basis of direct extension of infection from the gallbladder to the pancreas by way of a rich system of lymphatics. This same process would hold true as in the extension of infection from an inflammatory gastric or duodenal lesion, most frequently ulcer, as the anatomical proximity to the pancreas is common to all. The fact that in early acute pancreatitis the head is the part most frequently involved, and as the head juts directly into that retroperitoneal area most rich in lymphatics, this observation is offered as corroborative of this evidence. The part played by duodenal diverticulas situated at the ampulla of Vater has not been studied sufficiently. Here it would be possible for bile to stagnate, produce an irritative edema, become infected and produce a secondary inflammatory edema, obstruction of the common duct and reversal of the biliary flow. Considering the

increasingly large number of duodenal diverticulas, which are being demonstrated at this site, through or because of improved methods of roentgenography, speculating upon such a possibility, although found admittedly infrequent, is justified. Unfortunately, the surgeon operating upon a patient with acute pancreatitis, in fairness to the patient's chances of recovery, has not the time for extensive exploration to determine whether or not a diverticulum at the ampulla is present. Such exploration would hardly be justified and the difficulties attending the actual identification and exploratory examination of such a diverticulum if present should not be minimized.

Embolism of the pancreatic artery or one of its branches can also be taken into consideration as a possible etiological factor in the production of acute pancreatic disease. Along the same line of reasoning as that in production of ulcer, a small embolus or a shower of emboli acting to cut off locally small sections of pancreatic substance from their blood supply with ensuing production of local necrosis, extension of this necrosis, et cetera, might well be the mode followed.

In passing one might mention the association of acute hemorrhagic changes in the pancreas with acute alcoholism as verified fairly commonly at autopsy. That some pancreatic changes, particularly as regards blood sugar levels take place, is evidenced clinically by the cases which following an alcoholic bout complain of hypoglycemic reactions.

The actual pathological changes found in cases of acute pancreatitis coming to autopsy need not be described extensively here. Essentially, they are hemorrhage, fat necrosis, possibly suppuration and even gangrene. There may occur the formation of large or small sloughs into a nearby hollow viscus, chemical peritonitis at first, then secondary invasion by bacteria, paralytic ileus of the bowel, suppurative peritonitis with possible abscess formation in the pancreas itself and gangrene. These are the various deviations from the normal possible. Osler reported a case in which

as far as he could reason the pancreas sloughed *en masse* into the transverse colon, was passed by the patient by bowel and recovery took place. Were anyone else but Osler to have described such a phenomenon, it is quite certain that it would have been met with an unusual amount of skepticism.

#### SYMPTOMATOLOGY

For the past forty to fifty years the standard textbooks of medicine have been describing in a rather melodramatic way the symptoms of acute hemorrhagic pancreatitis. Invariably, the symptoms of shock and collapse have been overemphasized, similarly to the old descriptions of perforated peptic ulcer, in neither of which type of case is this essentially true. Such descriptions occur so systematically repeated that one wonders if the authors of such supposedly authoritative sources of information do not lift some previous work and change here and there either the wordings or grammar, inject a personal observation, but either due to lack of time or sincerity, do not in truth produce a work wherein every disease description is brought completely up to date in the light of contemporary individual experience.

Pain is of course the paramount symptom. It is sudden in onset, steady, continuous, without remission, located focally just above the umbilicus, usually transmitted straight through to the back, to serve to confuse us more in our differential diagnosis of perforated duodenal ulcer, rupture of the gallbladder, stone in the common duct and what not. Clinicians have studied the radiation of this pain. Statistics are offered and the consensus is that radiation straight through to the back is one of the almost constant features of acute pancreatic disease.

When one has mentioned pain, sudden in onset, localized in an area just above the umbilicus, severe, sharp, radiating through to the back, some degree of nausea and vomiting and then some degree of prostration and shock, one has covered about all

that is present in acute pancreatitis but, unfortunately, the same symptom complex describes a great many other acute upper abdominal conditions.

Earlier writers stressed the fact that the pain was so severe that it did not lend itself to control by morphine but such a statement deserves some degree of qualification and unfortunately such a phenomenon is present also in other upper abdominal emergencies, so that the point is of little value in differential diagnosis.

On physical examination nothing specifically objective presents itself to help in differential diagnosis. Perhaps the most important point that can be stressed is that these patients are not in a state of extreme shock or collapse as the older writers and textbooks were so apt to paint the picture.

The mere fact that in a high percentage of cases the pulse, although it may be decreased in volume, is under 100, would bear out the above statement. In addition, the fact that there is no drastic drop in the blood pressure readings is also confirmatory evidence.

If temperature is present, it is almost always in the vicinity of 100°F., but in the earliest stages of the illness may be normal or even subnormal.

Tenderness, spasm and rigidity in the epigastrium are always present but not in any different manner as to their degree or localization that might give any aid to diagnosis. They are quite apt to be similar to that in perforated ulcer or in the colic of cholelithiasis.

Leucocytosis is invariably present, averaging usually between 10,000 and 15,000 and by some it is thought that an extremely high leucocytosis, say in the vicinity of 25,000, is indicative that suppuration has occurred.

The sedimentation rate of the blood in these cases has been found to differ so erratically that it is not of any use or value.

The urinary findings are negligible. There may or may not be an albuminuria of varying degree, bile may be present in the urine, particularly in those cases in which

some biliary pathological condition is co-existent, and sugar may also be present not due to the destruction of insular tissue but more often due to a pre-existing diabetes.

The blood sugar level is unreliable for use in determining anything of value as to diagnosis, prognosis or treatment. It was rather interesting to read a recent paper written upon this subject and finding the clinician doing glucose tolerance curves on an emergency patient, losing valuable time and subjecting a patient to a multitude of laboratory studies, which lead finally to a meaningless conclusion, while the patient probably passed on to meet his Maker.

#### LABORATORY DATA

One procedure alone has been found to be of some help in the early diagnosis of acute pancreatitis and that is the determination of the blood diastase. This point is of sufficient importance in a field so barren of help that further elaboration is not amiss.

First an explanation is in order as to the sources other than the pancreas from which amylase may be made available to the blood stream. These are the liver, the salivary glands and the duodenum. That these sources furnish an adequate supply of amylase is demonstrable by an experiment. In complete extirpation of the pancreas in experimental animals there will be an initial drop in the blood diastase level with a subsequent return to a normal or slightly below normal level. It is this fact which explains why a blood diastase determination is of value only in the early phases of acute pancreatitis before a compensatory mechanism has begun to supply diastase from other sources.

The explanation for a rise in the blood diastase level in acute pancreatitis lies in the fact that with a rapid destruction of acinar membranes, such as takes place in this condition, there is a sudden overflow of pancreatic diastase into immediately surrounding pancreatic tissue not capable of

holding this overflow or of confining it, so there remains no other avenue of escape for it except into the blood stream. If coupled with this there is an obstruction of the pancreatic ducts, a vicious cycle is completed: there is more pancreatic tissue destruction, more ferment set loose and more taken up by the blood stream, so that an estimation of the amount present in the blood at such a stage will invariably show a very high amount over the normal.

The blood diastase level is, therefore, of help only in the earliest stages of acute pancreatic disease, when the greatest amount of destruction of tissue takes place. If the process is an unusually severe one, death has intervened in thirty-six to forty-eight hours, and blood diastase determinations are meaningless. If the process is one which has reached its height at its very beginning or shortly thereafter and the destructive process is subsiding, the blood diastase level will be levelling off and will lose its significance. There is also the possibility in an extremely severe case, of the blood diastase level being below normal instead of above, because such an unusual amount of tissue destruction in the pancreas has taken place so quickly that no pancreatic ferment at all is being produced, none is available for absorption into the blood stream and, therefore, the blood content of it is low.

The value of repeated blood diastase estimations as an aid to judging whether the disease process is progressing or regressing is important. Many cases have been cited in which the rise and fall of the diastase content of the blood exactly coincided with the peak and subsidence of the attack.

Serum lipase determinations follow about the same trend as serum diastase but the value of this test is sharply handicapped in that it requires a twenty-four-hour incubation period before estimation can be done.

The clinical evaluation of the blood diastase test is perhaps best expressed in the words of Gray<sup>1</sup> who summarized as follows, "*elevated diastase values are always*

*indicative of acute pancreatic disease provided the clinical picture resembling acute pancreatitis is present.*" . . . "Repeated normal blood diastase levels made early during the height of an attack of acute upper abdominal pain exclude the pancreas from consideration." In order that no smug complacency may develop with regard to this blood diastase test it would be well to enumerate some of its deficiencies: First, only a few laboratories in smaller hospitals and medical centers are equipped (although the equipment necessary is not extraordinary) to do quick emergency estimations of blood diastase. Second, there is a wide divergence of opinion as to what is the normal blood diastase level, as it varies widely in different individuals and under different conditions.

Low serum diastase levels, sudden drops or rises have not yet been adequately explained, at least to the point where one may have supreme confidence in using it as a diagnostic aid except in the one situation mentioned, early pancreatic disease.

Many clinicians prefer to use urinary amylase or diastase determinations, believing that they have the same value as that of the blood. That is a matter of personal preference, but it might be mentioned that with all the divergences possible blood diastase levels fluctuate less widely than urinary. A lack of standardization exists with regard to both of these tests and should be remedied as soon as possible.

No better summation of the value of the amylase or diastase tests could be made than that of Gray<sup>1</sup> quoted above.

The diastase value of normal human blood plasma ranges from 80 mg. to 150 mg. and the average about 115 mg. This is to indicate that 100 cc. of blood plasma or serum will produce a quantity of reducing substance equivalent to reducing 80 to 150 mg. of glucose. In about 10 per cent of human beings the value may be low between 60 to 80 mg. and in a smaller percentage may be high ranging around 200 mg. In acute pancreatitis or obstruction of pancreatic ducts the diastase of the blood

lies to multiples of normal and may be as high as from 1,000 to 3,000 units.

The relationship of the urine amylase to blood amylase is from two to six times greater in the former. Usually, a high blood amylase goes along with a high urine amylase. The blood amylase would be high only at the height of attack and subside rapidly with resolution of the acute process. This is important because in many instances the height of the acute attack may be only of a few hours' duration. A negative finding in an acute upper abdominal emergency or rather a normal finding will definitely rule out the presence of pancreatic disease.

For making the best use of the above tests laboratory service should be available at all hours, the technician familiarized with the technic by doing the test at intervals on any type of case thereby decreasing error possibility and the establishment of a "normal" based upon the experiences and technic of that individual laboratory.

The differential diagnosis of acute pancreatitis is by no means easy. Consideration must be given to any of the acute upper abdominal emergencies. Most prominent in the order of the frequency of occurrence will be acute cholecystitis, with impending gangrene or rupture, rupture of a gastric or duodenal ulcer or stone in the cystic or common duct. Less prominent but to be kept in mind are acute intestinal obstruction, mesenteric thrombosis, crisis of tabes, coronary thrombosis or occlusion.

It is in these cases in which keen perception in diagnosis and evaluation of minor details correctly can turn the scales and save a patient's life. If by a correct differential diagnosis acute pancreatitis is deemed present, the decision whether or not to submit the patient to operation arises.

Here several factors come into play, a good knowledge of which will aid in formulating a decision. Anatomically, the pancreas consists of multilobulated sections of tissue specifically differentiated to per-

form certain functions, mainly the production of digestive ferments. Each of these lobules is separated from the other by a connective tissue sheath, so that each lobule is a functioning gland all to itself and the whole is contained in a capsule, composed of rather closely knitted connective tissue, not capable of much expansion. In acute pancreatitis the process is one of quick necrosis involving many of these lobules or even all. A long incision into the pancreas from the head to the tail certainly cannot hope to accomplish much other than to release into the peritoneal cavity the highly toxic end products of a necrotic process and liberate tissue digesting ferments, particularly the proteolytic enzyme, trypsin. It is a question whether such a process would be of any help to the patient. It is obvious that to incise and drain each separate pancreatic lobule would not be feasible and could accomplish no more than the above.

The removal of free fluid from the abdomen is about all that can be hoped to accomplish or simple insertion of a drain if suppuration or abscess is present, but is it not also the opinion of most that a closed peritoneum has greater defensive power than one which has been injured by incision?

In a patient already in a state of shock, his or her power of resistance definitely lowered, anesthesia and operation may constitute the added straw that he is unable to bear and be the primary cause of death.

It has been shown that the pancreas itself has remarkable recuperative power and that this power is enhanced in the presence of a closed peritoneum; therefore, everything should be done to avoid submitting these patients to operation if possible.

In these cases in which biliary change is a contributing factor, the problem becomes seriously complicated. Drainage of the gallbladder is the simplest surgical procedure feasible. Stone in the common duct, necessitating exploration of the duct, is usually too heavy a procedure to be borne

well by a patient unless possessed of an unusual power of resistance and recuperation.

One can divide the cases of acute pancreatic disease into two types: the idiopathic acutely severe hemorrhagic and necrotic type, and the usually less severe but also acute type in which there coexists definite biliary tract disorders, probably the etiological cause of the disease.

It is here that keen diagnostic skill can come into play. If the symptoms are violent the state of shock severe, the blood diastase and urinary diastase levels high, extreme conservatism and operative interference only as a last resort are indicated.

If the symptoms are not too violent, the state of shock not too severe, the blood diastase and urinary diastase levels sufficiently high as to be suggestive, a fair clinical judgment that a perforated ulcer or gallbladder does not exist, delay is also indicated. If operation is decided upon, it is to consist only of draining the gallbladder and removing fluids from the peritoneal cavity.

Unfortunately, the x-ray can give us no help at all in these cases of acute pancreatitis. Negative evidence, that is against pancreatic disease, may occasionally be encountered such as air under the diaphragm indicating rather a perforation being present or the scattered puddling such as one would find in an obstructive intestinal lesion.

#### SURGICAL PATHOLOGICAL CONDITIONS

Here an extensive detailed description is unnecessary. The gross changes confronting the surgeon may fall into one of four different types, more often than not more than one type of change is present or one phase may be passing on into another, thus explaining the presence of more than one type of tissue change present at one time. These phases or changes may be classified as follows:

(A) *Simple edema*, wherein the pancreas as a whole is swollen, edematous, blood vessels congested and engorged, capillary edema but no hemorrhagic change has

taken place. (B) *Hemorrhage*, diffuse hemorrhage involving the entire organ almost invariably, with extensive destruction of tissue, particularly fatty lobules, but with no gross evidence of actual necrosis. (C) *Necrosis*, changes similar to those of a hemorrhagic process possibly more extensive, as this usually represents a very severe or an extension of a hemorrhagic process with actual necrosis in whole or in part of the pancreas. If this is an extension of a hemorrhagic process, the changes characteristic of both hemorrhage and necrosis will be present. (D) *Suppuration*, abscess formation which may or may not be localized within the pancreas itself. If not localized it rapidly spreads into adjacent tissue and particularly the peritoneal structure.

#### THERAPY

An abrupt reversal in the management of these cases has taken place. Formerly, the dictum was that the earlier the operative intervention the better were the patient's chances, this in spite of the fact that operation *per se* accomplished nothing more than a "look see," a verification of diagnosis at best, and injured the invasional defenses of an intact peritoneum. As we look back in retrospect it is hardly probable that the mere suctioning off of some hemorrhagic fluid was of any help to the patient. Those who did survive did so by the Grace of God and a strong constitution, and not because of any surgery. Operation is indicated where there is any doubt as to the diagnosis rather than let a patient die from a possible ruptured ulcer.

Today that is changed and for the better. A study of comparative statistics of ten, twenty and thirty years ago shows that diagnostic acumen has undoubtedly improved if measured by the higher percentage of accurate diagnosis, and the mortality tables lowered as measured by the number of cases listed as recovered.

The accepted treatment today is supportive and symptomatic in all cases except those in which the indications are that suppuration has intervened. Then and only

then surgical drainage might be of benefit. Therapy, therefore, divides itself into the following measures:

1. *Relief of Pain by Liberal Use of Morphine.* In addition to the use of morphine personal experience in the use of nitroglycerine has been gratifying although in too limited a number of cases. Theoretically, one may claim advantages for its use; it has antispasmodic and vasodilation properties. Through use of these it is conceivable that should any spasm of the sphincter of Oddi be present it could be overcome. In its action of dilatation of the common bile duct one would be warranted in assuming that the smaller ducts such as the duct of Wirsung or Santorini might in some degree also be dilated. Its use would tend to overcome any increase in biliary pressure or any reflux of bile due to such pressure, were it present. The above is along the same line of reasoning as that suggested for its use as an aid in the passage of a stone left behind in the common duct at operation.

2. *Relief of Gastric Distress.* First and most important here is that nothing shall be given by mouth, as stimulation of pancreatic ferment production in the tissue still intact would take place and thereby hinder rather than help the situation.

3. *An indwelling Levin catheter* with the frequent removal of stomach secretions is of material help. It is not necessary to have continuous suction, such as in cases of obstruction.

4. *Maintenance of Fluid Balance.* Here the question of administration of glucose in a case of impaired pancreatic function brings up a problem. First, the question of stimulation of pancreatic activity, which is to be avoided if possible, and secondly as both hyper and hypoglycemia states have been found in this condition, the use of intravenous glucose is debatable. In fact, in some cases in which shock has been present it was debatable whether the state of shock was due to the disease or to a hypoglycemia present as the result of the overproduction of insulin. One may take a

middle of the road path by giving with glucose solution a sufficient amount of insulin to counteract it. Physiological saline or Ringer's solution may be used in amounts corresponding roughly to an estimation of the fluid loss caused by vomiting and perspiration.

5. *Surgical intervention* is indicated wherever there is reasonable doubt as to the correctness of the diagnosis or whenever signs of suppuration intervene.

In advanced pancreatic necrosis or in pancreatic abscess, drainage of the pancreas is accomplished by incision of its peritoneal capsule and the insertion of multiple drains into either definite necrotic or suppurative areas.

The care of the skin and abdominal wall against the action of the tryptic ferments released by drainage is distressing to say the least and is worthy of a written paper of itself.

Some have advocated cholecystectomy as a measure for relieving biliary compression. That is a matter of surgical judgment based upon the individual case but it is difficult to see where it presents many advantages.

It is a more prolonged operation superimposed upon a patient who is already depleted in physical reserve because of his fight against an already present serious condition, and it is difficult to visualize wherein removal of the gallbladder will be in sufficient time mechanically to help relieve an edematous duodenum which is acting by the edema present to close the sphincter of Oddi. Bile will continue to come down the hepatic duct and if there is an impassable barrier at the duodenal and bile duct junctions the same conditions for increased tension and reflux of bile into the pancreatic duct, although it is admitted in perhaps a slightly lesser degree, will remain.

It would seem that cholecystostomy offered more advantages. It is faster and easier to do and carries less shock to the patient. It decompresses the biliary system immediately by offering another outlet

for the escape of bile. If gallstones are present in the gallbladder, they can be removed. There is one prime factor which must be present when deciding to do a cholecystostomy, and that is the cystic duct must be patent. It is quite obvious that draining the gallbladder above a closed or blocked cystic duct would hardly help in decompressing a hypertensive biliary system.

Those against cholecystostomy argue that there is a high rate of recurrent pancreatitis following this operation which does not exist after cholecystectomy, and that cholecystectomy has to be done eventually for relief of this recurrent pancreatitis, so why not do it in the first place?

A careful and fairly exhaustive review of the literature of the past forty years is rather barren of citations of cases wherein acute pancreatitis occurred a second distinct and separate time after survival of a first attack. Exacerbations of the primary attack, yes, but a second siege separated by a reasonable interval from the first one is very rare.

A word might be said as to the prophylactic removal of the gallbladder in each and every case in which stone is present and in those cases of chronic cholecystic disease of dysfunction without stone which do not respond satisfactorily to adequate medical management as a possible preventive of a later pancreatitis. So much evidence exists of the high association of gallbladder disease with pancreatitis that much weight could be given to the proposition that it might be one of the more important etiological factors in its production.

Incision and drainage of the common bile duct is recommended by others and presents many advantages from the standpoint of relief of biliary pressure, but it also presents disadvantages in that it is a more extensive operation to impose upon an already seriously ill patient.

Primarily, surgical intervention in these cases is unwarranted unless signs of biliary tract obstruction co-exist or evi-

dence of suppuration supervenes. Operative risk progressively increases after the first twenty-four hours.

The treating of these patients conservatively has resulted in a marked diminution in mortality. This can be seen by comparing the varying statistics available.

After an attack of acute pancreatitis, if recovery occurs, there may be some complicating sequelae. Among these might be mentioned the later development of pancreatic cyst, single or multiple, disturbance in carbohydrate metabolism, because of destruction of the isles of Langerhans, disturbance of fat metabolism, with hypercholesterolemia, lipemia and xanthomas or enlargement of the liver or spleen due to fatty infiltration.

Whipple,<sup>2</sup> in 1923, described a syndrome of "pancreatic asthenia" as a frequent and serious sequel in these cases. The predominant symptoms were asthenia, apathy, progressive loss in weight, hypotension and a generally downhill course with a high eventual mortality.

Chronic pancreatic disease presents a field in which little has been added to supplement the seven lines devoted to it by Osler fifty years ago.

Recently, there has been an impetus to the study of small intestine dysfunction. Out of the numerous investigations taking place at the present time there may come some clue which will help in our better understanding of this condition, at least may we hope so, and inasmuch as small intestine dysfunction is so closely allied with pancreatic function, it is to be hoped that out of all this investigative work we may come to a better understanding of chronic pancreatitis.

There are many reasons for the lack of knowledge as to chronic pancreatic disease. The organ itself has intrigued the laboratory research man much, but the clinician little, and the latter has been inclined to let it be the "forgotten organ" of the human mechanism. This may be because the tests for pancreatic enzyme function have been complex and unsatisfactory and because

the symptoms produced by functional change were vague and did not adapt themselves easily into a concept of a single symptom entity.

That phase of misunderstanding and lack of interest is undergoing rapid reversal and in reading the gastrointestinal literature of the past three to five years one becomes apprehensive lest the pendulum swing too far and pancreatitis become the diagnosis of fashion and go through the same public acceptance as did colitis and duodenitis.

With the introduction in 1934 of the Miller-Abbott method of small intestinal intubation, thereby making the procedure of obtaining uncontaminated duodenal content rather simple, there came a grand impetus in the study of pancreatic secretion. Following this method it has been possible to study rate and degree of absorption of solutions of glucose, peptones and various proteids. By the use of occluding balloons peristaltic activity and muscle tone changes can be recorded. One of its foremost uses is that it allows duodenal content to be aspirated uncontaminated by gastric content which is simultaneously or previously aspirated through the higher lumen. It can readily be seen that this means of obtaining pure pancreatic juice is a distinct advance over that heretofore existent of using a pancreatic fistula, difficult to obtain in a human specimen, and over all previous methods which were unable to surmount the hazard of contamination of duodenal content by gastric juice. By means of this new tube one is able to collect duodenal juice unmixed with gastric juice.

As a result of this means of study being available a new technical method of making the diagnosis of chronic pancreatic disease gives some promise. One of the functions of the pancreas is to produce the three digestive enzymes, trypsin, amylase and lipase, and to deliver these by way of the pancreatic duct and the common bile to the duodenum. The amount and character of this pancreatic secretion is under the control of the vagus nerve, influenced

undoubtedly by certain endocrine hormones, and of a chemical product produced in the duodenal mucosa, called secretin.

Bayliss and Starling first discovered the presence of secretin in the duodenal mucosa and described its specific effects upon the excretory cells of the pancreas. Since then many attempts have been made to isolate the hormone and to make use of it experimentally and clinically. It was not until 1934, when two research men, Hammarsten and Agren, in Stockholm, accomplished this.

Secretin, commercially, is an extract prepared from the duodenum of the hog. It is a whitish powder, readily soluble in water, stable in character and not affected by boiling. It is nontoxic and has no effect on blood pressure. It acts upon the pancreas similarly to histamine upon the stomach, and similarly occasionally produces slight temporary flushing of the face.

When injected intravenously it produces a marked flow in pancreatic juice, rich in bicarbonate and enzymes. The factors which can be determined are: (1) Volume of flow, (2) concentration of bicarbonate, and (3) concentration and quantity of enzymes, trypsin, amylase and lipase.

The correlation of the findings to clinical symptomatology leaves as yet much to be desired. At the same time much that is valuable is made available to the physician. As an example many cases of moderate diarrheas which could not be explained on an emotional, endocrine or achylic basis can be explained if a duodenal content of lowered total enzyme content and lowered bicarbonate concentration is found.

Cases in which there is a bulky, soft, bubbly fetid stool accompanied by various and sundry dyspeptic symptoms and which we have often in the past classified as nontropical sprue now become more readily interpreted when gross deficiencies in the pancreatic secretion is established.

Pancreatogenous diarrhea in which the stools show large amounts of fat and undigested proteids while not frequently encountered clinically in adults, and in

which pathological examinations of pancreas specimens in children has demonstrated a process of cystic fibrosis in the pancreas, invariably show gross changes in the pancreatic ferment concentration or even absence of such.

Clinically, this problem of chronic pancreatitis is as yet hidden in a maze from which it must emerge. Chronic pancreatitis should always be suspected when the roentgenologist reports no disturbance of the gallbladder function and the absence of stone yet the patient is complaining of symptoms referable to the gallbladder.

Hyperinsulinism may be a clinical manifestation of chronic pancreatitis. Hyperinsulinism and hypoglycemia in patients with vague gastrointestinal distress but stressing dizziness, body trembling or syncope should be suspected and more accurate blood sugar studies made, particularly glucose tolerance curves over longer periods of time, say six hours, and hyperinsulinism interpreted not as an entity *per se*, but as a manifestation of disturbed pancreatic tissue function, pancreatitis. In chronic alcoholism wherein hunger and weakness are prominent symptoms chronic pancreatitis should be suspected and blood sugar studies and pancreatic ferment determinations in gastrointestinal examinations may often give a clue to pathological conditions present and prove of value.

#### THERAPY OF CHRONIC PANCREATITIS

- I. Dietary
  - a. High carbohydrate intake to stimulate the production of amylip-sin. It has not been experienced that a high proteid diet influenced the clinical picture
- II. Elimination of direct pancreatic depressants
  - a. Alcohol
- III. In patients with associated hypochlorhydria
  - a. Small doses of free hydrochloric acid
  - b. Iron in readily assimilable form

c. Vitamin A has been advocated to stimulate pancreatic function

iv. Pancreas substance

For many years the oral administration of pancreatic substance has been a debatable point. Many believe that pancreatin is inert when given by mouth. Clinical response does not bear this out, as many of these patients when given pancreatin in suitable dose report definite clinical improvement.

v. Perhaps most important from the standpoint of preventive medicine is the association of chronic gallbladder disease and acute pancreatitis. When there is a nonfunctioning gallbladder which fails to respond in a reasonable length of time to accepted methods of medical therapy, it should be removed, eliminating the hazard of a possible acute pancreatitis later. When stone is present in the gallbladder, nothing further need be said; the source of chronic irritation should be eliminated.

Perhaps the most valuable procedure added recently to the treatment of the acute phase of pancreatic disease has been the use of ephedrine. Several observers have reported that in dogs the average twenty-four hour secretion of pancreatic juice can be depressed from 30 to 35 per cent by the use of ephedrine. Applying this observation to the treatment of acute pancreatitis in humans, Jacquet, in Paris, used massive doses in the early stages of the disease with remarkable relief of pain particularly after morphine had proved ineffective, and with apparent beneficial effect upon the process itself. It is not difficult to visualize how such improvement could take place particularly in the very early stages of the disease in which perhaps only edema was present, and the vasoconstricting action of the ephedrine not only acted specifically upon the edema through the circulatory vessels but actually prevented further engorgement or edema by limiting the blood supply to the organ.

Ephedrine has also been used postoperatively in pancreatic cases for the relief of pain and for its beneficial clinical effect.

The use of x-ray in acute pancreatitis has been recommended based upon the possible similarity of its clinical effects upon postoperative acute parotitis and the similarity of the histology and pathological condition present.

### CONCLUSIONS

1. The most important item in the entire field of pancreatic disease is that in deciding for or against operation in the acute cases, to judge whether only an acute edema of the pancreas is present or if necrosis or suppuration are present, whenever this is possible.

2. There should be a wider use of blood diastase determination with a full appreciation that only in early acute cases can its possibilities be utilized.

3. The use of ephedrine in the early case where it can be assumed that edema alone is present, that more comprehensive studies and data be made available is recommended. The encouraging but meager reports available justify such a plea.

4. Duodenal intubation and the use of secretin in the study of chronic pancreatic deficiency is definitely of value, and the use of such procedure is encouraged more frequently.

5. The prophylactic removal of a diseased or poorly functioning gallbladder which fails to respond to adequate medical therapy is shown by experience to be of value. The same removal of a gallbladder containing stone goes without saying. As a prophylactic or preventive measure against acute pancreatitis, it is definitely recommended.

6. Statistical evidence favors conservatism in the handling of the acute cases and the mortality is much lower whenever this has been practiced.



# THAT HAZARDOUS EMINENCE, THE COLOSTOMY SPUR

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PERHAPS the simplest operation which the surgeon who operates on the colon is called upon to perform is the application of a crushing clamp to a colostomy spur. This procedure is carried out with such frequency, such ease and so little discomfort to the patient that little thought is ever given to the possibility of untoward complications occurring as a result of it. When such complications are more than theoretic possibilities, why they should be borne in mind by all enterotomists, and how they may best be avoided, it is the purpose of this paper to demonstrate.

Spur crushing was the answer of the pre-antiseptic era to the "anus praeternaturalis." Fecal fistulas in that day were most commonly the sequelae of spontaneous or operative "cure" of strangulated hernia; less frequently they were of traumatic origin. The investigations of the Italian anatomist and surgeon, Scarpa, showed that their obstinate persistence was often due to the presence of a "promontorium," or spur, which existed between the afferent and efferent portions of the perforated loop of bowel.

The earliest attempts to remove this promontory consisted simply of the application of pressure. Desault employed a roll of charpie as a tent for this purpose. Later surgeons tried other devices, such as Sedilot's sponge, Maurer's balloon, Diefenbach's crutch and Twitchell Banks' stiff rubber tube.

In most cases compression failed to remove the spur, and it soon became apparent that only destruction would accomplish this objective. This was first attempted by Schmalkalden in 1798, when he employed a blunt-end bistoury to cut the spur. Physik, in 1809, ligated and divided the spur. The extreme hazards of

these methods and their failure in his hands led Dupuytren to seek a safer method. After painstaking anatomic and experimental studies he devised the enterotomic. This instrument, applied to the spur, slowly tightened, produced adhesion of the opposing serous surfaces and made cutting of the spur by gradual pressure necrosis a comparatively safe process. His thoughtful observations as described in the *Leçons orales* indeed represent the acme of all contributions on the subject, before or since. Countless modifications and some improvements have been made on Dupuytren's enterotome, but the principles of all are essentially those which he elucidated.

In present day surgery of the colon the spur or *éperon* occupies a different position. It is the natural result of all procedures of the Mikulicz type, being formed by the adjacent surfaces of the two limbs of the exteriorized loop of bowel. These limbs may be sections of the terminal portion of the ileum and of the transverse colon, as they emerge from the abdomen in the case of right hemicolectomy; or both limbs may be portions of the colon, or one limb may be a part of the rectum, as in the case of rectosigmoid neoplasm brought out through a Kraske incision in an attempt to preserve the anus. Furthermore, a well formed spur is an integral part of any correctly performed colostomy. In its absence retraction occurs and the operation of colostomy then fails in its purpose of defunctioning the diseased distal segment of bowel. As Allingham stated, "if the spur fails, the operation itself is a failure."

To insure proper function of the colonic stoma, the spur must remain in place. Proper mobilization at operation will minimize the tendency of mesenteric tension to withdraw the spur. Maydl suggested

the use of a rigid rod to hold the loop well up until firm adhesions had formed. Both Allingham and Ward employed a mattress stitch which fixed the mesentery to the abdominal wall, a method also advocated by Moynihan. Many surgeons use some modification of Mixer's bridge colostomy, in which all layers of the abdominal wall are united beneath the exteriorized loop of bowel. Devine and others have carried out the suggestion, originating with Verneuil, of complete division of the bowel and performance of double-barrel colostomy.

When subsequent closure is contemplated, other factors must be taken into account in addition merely to prevent retraction of the spur. The afferent and efferent limbs must be carefully approximated so as to prevent interposition of important viscera which might be injured in crushing the spur. The limbs should be rotated so that the mesenteric blood supply will not be occluded by the enterotome and unnecessary pain occasioned by inclusion of the mesentery between the blades. Formation of a long spur facilitates closure because a large, direct communication between the proximal and distal limbs can be established readily, thus re-establishing normal intestinal continuity.

The instruments which have been devised for division of the spur are legion. Dupuytren's enterotome consisted of two blades which could be disarticulated for insertion into the bowel. Pressure was applied by means of a thumbscrew. Mikulicz used an elastic band to produce gradual pressure on the *spornqueische* which he employed, as did Prince, with his hook and ring apparatus. Krause used a clamp which exerted pressure on the deep part of the spur to anastomose the adjacent intestinal loops, an instrument which has its modern counterpart in the clamps of Devine and of DeBakey and Ochsner. Various types of hemostats, such as the Kelly forceps and the Kocher forceps, are widely used as enterotomes, the instruments being tightened one notch daily. Garlock described a long-bladed, right-angle clamp in which

parallel approximation of the blades was achieved by a thumbscrew, as in the clamp employed by one of us (C. N. M.). Cope<sup>22</sup> devised an instrument which is applied at the time of the primary operation. It consists of two hollow metal tubes which are tied into the upper and lower segments of the divided bowel for purposes of decompression. These tubes can be approximated gradually, and ridges mounted on their adjacent surfaces crush the interposing septum. Reybard devised an enterotome which cut and crushed simultaneously. Liotard used a punch enterotome which cut out a circular flap. Pauchet practiced immediate division of the spur between clamps, suture of the cut edges and closure of the stoma at the same time.

To be sure, some surgeons believe that the time-honored method of destruction of the spur has no place in modern surgery. As early as 1894 Senn thought the operation would soon be obsolete, because of recent advances in intestinal surgery. Today Lockhart-Mummery<sup>11, 12, 13</sup> is perhaps the most ardent advocate of intraperitoneal resection and anastomosis for treatment of the colonic stoma. He believes that crushing of the spur and extraperitoneal manipulation constitute poor surgical technique, suitable only for the inexperienced surgeon or for markedly debilitated patients.

Restoration of intestinal continuity after operations on the colon is purely a matter of convenience to the patient. A colonic stoma does not jeopardize his life or health. Since it is not an operation of necessity, it would not seem justifiable to employ methods which carry an appreciable risk when simpler and safer methods are available. However, even the simplest procedure (namely, the application of clamps) is not to be so lightly regarded as to be thoughtlessly or carelessly performed. Reports of accidents in destruction of the spur in recent years are meager, and warnings against their occurrence are seldom seen. Lockhart-Mummery<sup>11, 12, 13</sup> stated that he had never seen peritonitis or death occur

after the use of the enterotome and numerous others have stated that the operation is "perfectly safe."

That this is not invariably true was well known to early writers on the subject. In three of Dupuytren's forty-one reported cases death occurred; one patient died from escape of feces into the abdomen, one from "indigestion," and one from "intense peritonitis." Velpeau pointed out that the adhesions about the spur were sometimes scarce, and did not invariably form at the periphery of the enterotome. One of his patients succumbed to peritonitis after acute perforation of the bowel by the enterotome. He also stated that in some cases it was almost impossible not to include between the two "branches" a portion of some important organ. Chaput, as a result of his experimental, histologic and clinical studies, concluded that rapid crushing or use of the enterotome on any but long, thin spurs, was decidedly dangerous.

The accidental spurs these surgeons dealt with were different from the spur planned and created in the operating room of today. But the perfect spur cannot always be obtained. An obese abdomen, a short mesentery, the need for extensive resection and other technical difficulties may result in two widely divergent limbs. On the resulting broad, shallow spur, clamps must be used with great circumspection, if at all. Even under the most ideal conditions, accidents still can and do happen and it behooves the surgeon to be aware of this possibility, to be on the alert for their occurrence and to be ever cautious in applying any crushing instrument.

The following illustrative cases, in which the patients were seen at the Mayo Clinic in the past few years, will serve to indicate the types of mishaps which can occur:

#### CASE REPORTS

**CASE I. *Acute Perforation of the Bowel, General Peritonitis, Death.*** A man forty-nine years old, had a carcinoma of the lower portion of the sigmoid. He was first treated by left inguinal colostomy. A month later, extra-

peritoneal removal of the neoplasm was carried out. Clamps were applied to each spur several times. One and a half years later he returned with a persistent fistula at the site in which the original colostomy had been performed. A spur was still present and, accordingly, two curved clamps were applied. The next day the patient was up and about. On the third day he was suddenly seized with severe pain in the left lower quadrant of the abdomen. The abdomen became rigid. He had a chill and his temperature increased to 103°F. (39.4°C.). From that time onward collapse was rapid, in spite of supportive measures and the use of nasal suction. One clamp was removed, but his shocked condition became progressively more profound, his color cyanotic and his pulse more rapid and feeble. On the fifth day he died. Postmortem examination revealed general peritonitis, with 1,500 cc. of purulent fluid present. The remaining clamp was found to have perforated the lower loop of bowel, permitting escape of intestinal contents into the peritoneal cavity.

**CASE II. *Injury to the Jejunum, Jejunocolic Fistula, Malnutrition, Death.*** A woman, fifty-seven years old, had a carcinoma of the transverse part of the colon. Exteriorization of the neoplasm was carried out, and ten days later the lesion was removed and a clamp was applied to the spur. During the next four months clamps were applied to the spur four times. Eleven months after her initial operation, the patient returned with a persistent fistula. A clamp was applied to the spur and partial closure of the stomach was performed. On the sixth postoperative day the clamp came off. Two days later a watery, diarrheic discharge from the wound began; this resulted in considerable excoriation of the skin. By the end of another week, it was found that food and dyes which she ingested appeared on the abdomen within one to three minutes. Suction applied to the colonic stoma almost resulted in healing several times, but each time the fistula would break open again. The patient's course during the next two months was one of progressive debility, hypoproteinemia, edema, unameliorated by the transfusion of blood and by dietary measures. Finally, surgical exploration was carried out, but only an enlarged liver was noted. Two days later this patient died. At postmortem examination she was found to have ascites (350 cc. of fluid) and hydrothorax

(1,000 cc. of fluid in each pleural cavity). The liver weighed 3,425 Gm. and exhibited marked fatty changes. The fistula in the right upper quadrant of the abdomen led by a 4 cm. tract to a pocket 3 cm. in diameter, which, in turn, communicated with an opening in the jejunum (3 cm. from the ligament of Treitz) and opened into the transverse portion of the colon.

**CASE III. *Injury to the Ileum, Ileocolic Fistula, Operation, Recovery.*** A man, sixty-four years old, had a carcinoma of the rectosigmoid. Extraperitoneal resection was carried out. Three weeks later a clamp was applied to the spur. The clamp fell off after ten days. About three weeks later, the stoma having almost completely closed spontaneously, the patient began to pass blood from a fistula. This was followed in a week by a scalding discharge which produced considerable excoriation of the surrounding skin. Roentgenologic study revealed a communication between the ileum and the descending part of the colon. When, after six months, only transient signs of improvement were noted, operation was decided upon. The ileum was dissected from the colon, the openings in each were closed, and the external opening was closed at the same time. Three years later this patient was in excellent health. Roentgenologic examination revealed no recurrence of the internal fistula, although a small external one persisted.

**CASE IV. *Injury to the Ileum, Ileocolic Fistula, Conservative Management, Recovery.*** At emergency appendectomy for acute appendicitis, a woman, sixty years old, was found to have a carcinoma of the rectosigmoid. Left inguinal colostomy was performed at the same time appendectomy was carried out. Two months later the neoplasm was removed by extraperitoneal resection, the old colonic stoma being excised. Exteriorization was difficult, the bowel was taut and the upper and lower limbs formed an obtuse angle with each other. After six weeks clamps were applied and nineteen days later a second application was carried out. The second set of clamps came off on the fifth day. The next day an almost continuous watery discharge from the colonic stoma was noted. The fluid resembled the contents of the small bowel and produced considerable excoriation. Examination revealed three distinct openings beneath the stoma; one was the lumen of the proximal loop of

bowel, one the lumen of the distal loop, and the third was the accidental opening in the ileum. Treatment was directed toward inhibition of peristalsis, addition of bulk and consistency to the intestinal contents and protection of the skin. As a result, the stools gradually became less fluid-like and less irritating, the external opening became smaller and most of the patient's stools passed normally through the rectum. At a future date the external opening will be closed if this does not occur spontaneously.

**CASE V. *Injury to the Ureter, Ureterosigmoidal Fistula, Conservative Management, Recovery.*** A woman, fifty-eight years old, had a carcinoma of the sigmoid. Exteriorization was carried out and eleven days later the neoplasm was removed and a clamp was applied to the spur. The next day the patient's temperature increased to 103°F. (39.4°C.), but gradually returned to normal before the clamp came off on the eighth day. Soon after this a low-grade fever began and the patient had five to six watery stools daily. Twenty days after the clamp came off she began to have chills, fever in which the temperature reached 103°F. (39.4°C.), abdominal pain, nausea and oliguria. The discharges from the colonic stoma assumed a urinary character. Urine from the bladder was clear. An excretory urogram revealed pyelectasis and caliectasis on the left. The left ureter was not visualized. The right side was normal. Cystoscopic examination revealed a normal bladder. No urine came from the left ureteral orifice and a catheter inserted into this orifice encountered complete obstruction at 12 cm. One month later the patient was sent home. Urinary drainage had decreased. The colonic stoma was diminishing in size. The excretory urogram revealed delayed function of the left kidney, in addition to the changes previously noted. It was believed that nephrectomy would be required ultimately.

**CASE VI. *Hemorrhage, Transfusion, Recovery.*** A man, fifty-four years old, had a carcinoma of the splenic flexure. Extraperitoneal resection was carried out and two weeks later a clamp was applied to the spur. The patient experienced an unusual amount of pain after application of the clamp, which remained in place for two weeks and finally was removed, although it was not completely free. The patient was sent home and two days later had a severe hemorrhage, passing large quantities

of blood from the colonic stoma and by rectum. His physician found him in a state of profound shock. Supportive measures were used, and serum was transfused once and blood twice. The patient had no further bleeding and returned six weeks later, at which time closure of the colonic stoma was carried out.

CASE VII. *Hemorrhage, Packing, Recovery.* A man, sixty-two years old, had a carcinoma of the sigmoid. Extraperitoneal resection was carried out. During the next six months clamps were applied three times. After the last application the patient's temperature increased to 101°F. (38.3°C.) and on the fifth day parotitis developed which was treated by roentgen-therapy. The patient left the hospital against his physician's advice before the clamp came off. On the eighth day profuse bleeding from the colonic stoma occurred. The patient was hospitalized, ice bags were applied to the abdomen, and a large gauze sponge was packed in beside the clamp, which was tightened as much as possible. Morphine was administered liberally. The next morning the value for hemoglobin was 8.9 Gm. per 100 cc., and the erythrocyte count was 2,900,000 per cubic millimeter. There was no further bleeding and the clamp was removed. Closure of the colonic stoma was performed two weeks later.

In addition to these patients we have seen a number who died, after the application of clamps, from such varied causes as bronchopneumonia, pyelonephritis, septicemia and general peritonitis. In these latter cases it would be difficult to determine how important a contributory rôle was played by the operation of crushing the spur. Most of these patients were thought to be in fairly satisfactory condition at the time clamps were applied; had this not been true, the procedure would not have been carried out. Necropsy revealed no direct relationship between death and clamping, that is to say, whether the patients would have survived had the operation not been performed cannot be determined.

#### SUMMARY

Serious and sometimes fatal complications may follow crushing of a colostomy spur. These complications may manifest themselves shortly after the application of

the enterotome, at any time while it is in position, or not until a variable time after it has come off. The occurrence of complications can be kept at a minimum by care in formation of the spur at the time of the original operation, by care in the application of the crushing device, and by proper management of the patient during convalescence. The clamp should be protected from traumatizing influences while it is in place and the activity of the patient should be limited. Confinement to bed is unnecessary but reasonably close surveillance is essential. Hasty tightening or premature removal of the enterotome is to be avoided. The surgeon should bear in mind the complications which may occur whenever unusual reactions follow the application of clamps or whenever he finds himself regarding the procedure as trivial or performing it thoughtlessly or hastily.

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THE degree to which fluid accumulations contribute to distension in obstruction depends essentially on the location and the degree of the obstruction, which in turn determine the fluid lost by vomiting. The higher the obstruction, the more readily are the intestinal fluids vomited. From "Intestinal Obstructions" by Owen H. Wangensteen (Charles C. Thomas).

# REPAIR OF PROGNATHIC AND RETRuded JAWS

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WHILE the less severe types of prognathism are treated by the orthodontist, the more marked deformities not only by cosmetic considerations, but also by the interference with mastication which necessarily results from marked



FIG. 1. A and B, prognathic jaw, before operation.



FIG. 2. A and B, prognathic jaw, after bilateral osteotomy.

formities (Figs. 1A and 1B) sooner or later come to the attention of the plastic surgeon.

Repair of a prognathic jaw is demanded

malocclusion. Prognathism can be successfully corrected by suitable plastic surgery, (Figs. 2A and 2B) or in milder cases, by appropriate orthodontic procedures.

### PROGNATHISM

The two chief methods for the plastic correction of prognathism are osteotomy



FIG. 3. Photodiagram showing skin incision and Gigli saw in place.

and osteotomy. In the former (the technic formulated by Blair<sup>1</sup>), a segment of bone is removed from each mandible, while in osteotomy, first suggested by Babcock,<sup>2</sup> the mandible is cut, and the distal segment pushed backward and immobilized in the overlapped position. Since Blair's method requires the plastic surgeon to invade the oral cavity, thus opening the channel to possible infection, I have preferred to avoid osteotomy and to repair prognathism by the simpler Babcock technic, namely, bilateral osteotomy.

Only local anesthesia should be used in this procedure. Under general anesthesia, the patient may vomit while his jaws are wired. The resulting insufflation of vomitus may cause serious complications. An incision 2 cm. in length is made along the posterior border of the ascending ramus. (Figs. 3 and 4.) The parotid gland is retracted and the masseter muscle pulled forward. The posterior border of the mandible is now exposed. A large ligature carrier, with a heavy black silk suture, is passed between the parotid gland and the ramus and then around the posterior border of the

ramus. The tip of the ligature carrier hugs the bone and is passed in front of the anterior border of the ramus, until the tip of the instrument can be felt under the



FIG. 4. Schema of jaw bone showing site of osteotomy.

skin. An incision is then made into the skin over the point at which the ligature carrier can be felt. The suture is then drawn through this new opening and a Gigli saw is attached to it. The Gigli saw is pulled back through this second opening and out through the original incision. The ramus is then cut through with the saw, above the entrance of the inferior alveolar nerve into its canal. The entire procedure is then repeated on the opposite jaw. The mandible is next pushed back into the desired position with the upper teeth as a guide. By means of orthodontic bands (Fig. 5) and stainless steel ligatures, the mandibular fragment is immobilized in its new position and wired to the maxilla. (Fig. 6.)

At the end of four weeks, small vertical elastic bands connecting maxilla and mandible replace the wires. The patient is then allowed slight movements of the jaws. For the next few months, the patient should be under regular orthodontic observation.

### RETRUDED CHIN

Another common mandibular deformity is retruded chin. This condition (Figs. 7 and 8) may be due to malocclusion, ankylosis of the jaw, osteomyelitis of the jaw or trauma.

Many procedures have been recommended for the treatment of retruded chin. One is bilateral osteotomy of the rami with

advancement of the mandible with or without bone grafts. A second method depends on the use of cartilage or bone grafts.

I have used both bone and cartilage grafts and find them satisfactory in minor deformities, but the amount of material needed to build up an extensive defect with



FIG. 5. Orthodontic bands in place before operation



FIG. 6. Teeth wired after operation.



FIG. 7. Profile of retruded chin, before operation.



FIG. 8. Full face view of retruded chin; before operation.

Mention may also be made of Gillies' method. This entails Thiersch-grafting of a pocket in the chin, followed by the use of a prosthetic appliance on the lower teeth. I have had some personal experience with this method, working with Sir Harold Gillies, and found that patients occasionally complained of irritation caused by food falling into the pocket. This method is also objectionable because it requires an excessive amount of sanitary attention on the part of the patient.

cartilage or bone makes the method impractical in large deformities. Ivory is mentioned only to be condemned; it is a foreign body, surgically objectionable for admission to the permanent human structure. A combined fat-and-dermal graft is preferable. The literature on fat as a graft material in retruded chin is very scanty, but my experience with it has been uniformly satisfactory. The fat-dermal combination is desirable because the amount available for a defect of any size is prac-

tically unlimited. Patients report that they find it more "natural" to have the feel of fat-and-skin than of some hard substance in the chin.

#### PROCEDURE

The first step in this procedure is to make a moulage of the face. The required chin

tus in removing the graft and serve to hold it in the chin pocket.

The epidermis of the abdominal wall is sutured back in place with a continuous suture.

The combined fat-and-dermal graft is immediately transferred to the pocket in the chin. This is held in place by the various



FIG. 9. Profile, retruded chin corrected by operation.



FIG. 10. Full face view, retruded chin corrected by operation.

height is modelled on top of the moulage and measurements are taken from this model, using gauze or linen as a pattern. The pattern is autoclaved and kept in the operating kit as a model for the graft. This pattern is placed on the chin and outlined on the skin in brilliant green, thus demarcating the extent of the undermining necessary. Incision is made on the lower surface of the chin, from which the undermining is done. Scrupulously careful hemostasis is necessary. This is best achieved by hot packs rather than by catgut ties. While an assistant controls the bleeding in the chin, the pattern is now transferred to the anterior abdominal wall and again outlined in brilliant green. The upper layer of skin is dissected off along three sides but not completely detached. The fat with the dermis on top of it is then removed from the tissue. Mattress sutures which are applied to the corners of the graft, act as traction appara-

mattress sutures which were originally used as traction sutures. The skin is carefully sutured. Drainage should not be used. A compressive dressing is applied. Fresh mechanic's waste, which has been washed and autoclaved, makes an excellent compressive dressing. The dressing should not be disturbed for at least five days. (Figs. 9 and 10.) Fat, when transplanted with the dermis attached, does not undergo atrophy nearly as readily as does simple fat graft. Whenever fat is transplanted for a skin defect, it is essential to overcorrect, to allow for shrinkage.

Chief bars to successful procedure are trauma, infection and bleeding. For this reason, exceptional care must be taken with regard to asepsis, hemostasis and gentleness in handling.

#### SUMMARY AND CONCLUSIONS

1. Marked prognathism is a problem for the plastic surgeon and can be corrected by

ostectomy or by osteotomy. In ostectomy, a segment of bone is removed from each mandible. This requires the surgeon to open the oral cavity, thus inviting possible infection. Bilateral osteotomy is safer and simpler. The procedure consists in cutting the mandible and pushing the distal segment back, immobilizing it in the overlapped position. To prevent vomiting, which might be hazardous, local anesthesia should be used.

2. Retruded chin can be treated by the use of a combined fat-and-derm graft. The fat does not atrophy as readily when transplanted with dermis as it does when

used alone. It produces a more natural "feel" to the patient than does bone, cartilage or ivory.

3. The operative steps in both procedures are described and illustrated.

Thanks are due to Benjamin Weiss, D.D.S. for his skilful work in applying the orthodontic bands and for administering the orthodontic postoperative care.

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WITH an injured limb entirely immobilized in correct length and position, the only indications for disturbing the limb or patient are those familiar to every surgeon—swelling, rise of temperature, increased white blood cell count, and local symptoms which point to the seal of surgical complications, if they occur.

From "Wounds and Fractures" by H. Winnett Orr (Charles C. Thomas).

# ACUTE APPENDICITIS\*

## AN ANALYSIS OF 417 CONSECUTIVE CASES

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THIS series of 417 cases includes all patients having acute appendicitis admitted to the surgical service of Knickerbocker Hospital during the four-year period from January 1, 1937, to December 31, 1940. All cases were proved by pathological examination of the removed appendix except in three instances of appendicial abscess in which the appendix was not removed. Both ward patients and those private patients operated upon by surgeons actively engaged in ward service are included.

TABLE I

Grouping	No.	Sex		Race		
		Male	Female	White	Colored	Yellow
Unruptured	300	161	139	289	11	0
Ruptured with spreading peritonitis	70	45	25	68	2	0
Ruptured with abscess	47	33	14	44	2	1
Total	417	239	178	401	15	1

The 417 cases were subdivided into three groups as follows: (1) Acute unruptured: the disease was confined to the appendix itself although there may or may not have been free fluid in the peritoneal cavity. There were 300 such cases. (2) Acute ruptured with spreading peritonitis: the process had spread beyond the limits of the appendix without apparent walling off. In this group there were seventy cases. (3) Acute ruptured with abscess: there had been a definite abscess formed about the

appendix. There were forty-seven cases in this group.

Age. The youngest was one year, the oldest eighty-one. Eighty-seven per cent of the cases occurred in the first four decades of life. The greatest number were during the second decade and this number was approximately one and a half times greater than that for the third or next largest decade. The following graphically shows the age spread:

TABLE II

Grouping	0-10	11-20	21-30	31-40	41-50	51-60	61-70	71-80	81-90
Unruptured	46	108	74	46	14	7	3	1	1
Ruptured with spreading peritonitis	15	19	8	12	6	6	4		
Ruptured with abscess	6	14	6	6	8	5	1	1	
Total	67	141	88	64	28	18	8	2	1

While individualization of each case is the ever present aim of every surgeon, a general plan of treatment has been evolved for the staff. It should be made clear that no surgeon is bound by this plan but its general principles are usually followed.

When a diagnosis of unruptured acute appendicitis has been made, operation is performed as soon as possible. When it appears that rupture has occurred and spreading peritonitis is present, operation is delayed until fluid and electrolyte balance can be restored. When an obvious appendicial abscess is present, the same general rule in regard to fluids and electrolytes holds, but delay in operation may be

\* From the Surgical Service of Dr. John V. Bohrer, Knickerbocker Hospital, New York, New York.

longer until complete localization has occurred.

The McBurney incision is preferred and the right rectus is reserved for those instances in which there is a possibility of a mistake in diagnosis and in which exploration may be desirable, or in those cases of appendicial abscess in which the abscess presents more medially than beneath the site for a McBurney incision.

In an appendicial abscess the appendix is removed whenever feasible. It is only when the patient is extremely ill or when its removal necessitates a too long or too extensive operative procedure that drainage alone is employed.

The stump of the appendix is treated in one of two ways: A purse-string suture is placed about the base of the appendix. The appendix is divided between two clamps with a scalpel dipped in phenol, the raw surface carbolyzed and then wiped with alcohol. The appendix stump is ligated with a No. 00 plain catgut ligature and the ligated stump is buried in the cecal wall. This is then re-enforced with a second inversion or a "z" stitch. The theory of this method is that while ligating the appendix in a crushed area prevents spilling and also hemorrhage, the fine ligature is loosened after a few hours and the appendicial stump is actually inverted into the lumen of the cecum. The second method of treating the stump is to ligate the appendix doubly in an uncrushed portion as near as possible to the cecum after having amputated it in the manner described above.

In patients whose appendix is unruptured there is a tendency to use less and less intraperitoneal drainage. There is a concomitant increase in the tendency to drain down to the peritoneum, using a slip of rubber dam or a penrose drain and to close the remainder of the layers up to the drain.

In the ruptured appendices, either with spreading peritonitis or abscess formation, the usual method of drainage is by use of penrose drains, which are soft rubber tissue tubes, extending into the peritoneal cavity.

The peritoneum is closed loosely up to the drains and the remaining layers of the abdominal wall are left unsutured, frequently loosely packing it open with vaseline gauze or packing. Occasionally, cigarette drains are employed and rarely (usually when an abscess cavity is present) a Mikulicz tampon.

In the patients whose appendix is ruptured, in whom distention and vomiting are to be expected, Wangensteen suction is begun immediately after operation. Heat is applied to the entire abdomen in the form of a large flaxseed poultice and an attempt is made to maintain fluid electrolyte and protein balance by the proper use of infusions and transfusions. Prostigmin and colon irrigations are frequently employed and sufficient morphine is administered to prevent restlessness.

Sulfonamide drugs have been given principally to those patients whose appendices have ruptured or to those who develop pneumonia. These have been administered by mouth, by rectum and intramuscularly, but in the present series none received the drug intraperitoneally.

#### SYMPTOMATOLOGY

The syndrome of pain originating in the epigastrium, paraumbilical region or general abdomen and localizing later in the right lower quadrant, proved to be the most common and the most reliable symptom. It occurred in 303 or 72 per cent of the patients in the series. In seventy-one or 17 per cent the pain originated and remained in the right lower quadrant. Generalized abdominal pain which did not localize was present twenty-three times. Pain in both lower quadrants was present on thirteen occasions and pain in the right upper quadrant and right lower quadrant was present five times. In two children, one five years old and the other one year old, no history of pain was obtainable. Thus, pain in the right lower quadrant either alone or in combination with pain elsewhere was present in practically 100 per cent of these patients.

There was a history of previous attacks in eighty-six or 26 per cent of the patients. Vomiting occurred in 287 or 69 per cent. Fifty-five or 13 per cent had constipation and twelve had diarrhea. Fourteen had a history of previous respiratory infection.

The most common sign was tenderness in the right lower quadrant which was present in all but three patients. In one no tenderness was reported, in the second rectal tenderness only was found, and in the third the tenderness was in the left upper and left lower quadrants.

In 189 or 45.6 per cent tenderness was found localized at McBurney's point, while in the remaining 225 or 54.4 per cent tenderness was diffuse in the right lower quadrant. Generalized tenderness or tenderness in the right upper or left lower quadrants occurred seventy-four times, mainly in those patients with spreading peritonitis.

Rigidity in the right lower quadrant was present in 314 instances or 75 per cent. There was no rigidity noted in 103 or 25 per cent. Generalized rigidity or rigidity in the right upper or left lower quadrants as well as in the right lower quadrant occurred seventy-five times.

In those patients with local abscess formation, masses were felt rectally three times and abdominally nine times or in 25.6 per cent of these cases.

Average temperature, pulse, and respiration were computed. In the unruptured group the temperature was 99.7°F., pulse 97, and respiratory rate 22.2. In those patients with spreading peritonitis the temperature was 101.2°F., the pulse rate 107.9 and respiratory rate 24.6. In the group with abscess formation the temperature was 101.2°F., pulse rate 100.1 and the respiratory rate 23.1.

The average white blood cell count for the unruptured group was 15,400, with 83.7 per cent polymorphonuclear leucocytes; for the group with generalized peritonitis 18,000 white blood cell count and 86.7 per cent polymorphonuclear leucocytes and in those patients with abscess

formation, 17,100 white blood cells and 84.3 per cent polymorphonuclear leucocytes.

TABLE III

Grouping	Average Temperature, °F.	Pulse	Respirations	White Blood Cells	Polymorphonuclears
Unruptured.....	99.7	97	22.2	15,400	83.7
Ruptured with spreading peritonitis.....	101.2	107.9	24.6	18,000	86.7
Ruptured with abscess.....	101.2	100.1	23.1	17,100	84.3

*Duration of Symptoms before Admission and before Operation.* In the group whose appendices were not ruptured, an average of 27.9 hours elapsed from the onset of symptoms until admission to the hospital. Seven hours elapsed from the time of admission to operation.

In those patients with peritonitis, the average time between the onset of symptoms and admission to the hospital was 45.2 hours, and 5.6 hours were consumed in preparing these patients for operation.

In those patients with abscess formation, the average time elapsed between onset and admission was 91.8 hours, and between admission and operation 41.8 hours. If five patients under observation periods of time varying from six to seventeen days were excluded, the average time would be thirteen hours.

*Cathartic or Enema.* In those patients whose appendices were not ruptured, approximately one-third received either a cathartic or enema before admission. Thirty-one or nearly one-half of the patients with general peritonitis received a cathartic or enema before admission, and in those with abscess, twenty-three or approximately one-half received a cathartic or enema during their illness. This again emphasized the well recognized fact that cathartics and enemas increase the likeli-

hood of perforation and contribute to the serious aftermath that perforation implies.

*Operation.* The McBurney incision was used alone 337 or 80.8 per cent, and the right rectus was used alone in sixty-five or 15.5 per cent of the operations. The two incisions were used together on three occasions, twice because the appendix could not be reached through the original McBurney incision and once because it was thought that further exploration was necessary to explain the symptoms. The Pfannensteil was used six times, upper right rectus and McBurney on two occasions when upper abdominal lesions were suspected and each of the following used once: hernia and right rectus, transverse, transverse with extension downward and Kammerer.

TABLE IV

	Unruptured	Peritonitis	Abscess	Total
McBurney	247	56	34	337
Right rectus	45	10	10	65
McBurney and right rectus	3			3
All others	5	4	3	12

*Drainage.* In those patients whose appendices were not ruptured, 103 or approximately one-third of the cases were drained. In fifty-two or about one-half of these instances the drain extended into the peritoneal cavity and in fifty-one or the remaining one-half, the drain extended down to the peritoneum. In three of the latter cases no sutures were used except in the peritoneum and the wound was packed open with vaseline gauze.

In this group there were 4.3 per cent wound infections. In eleven out of the fifty-two instances of intraperitoneal drainage the wounds except for peritoneum were left unsutured and none of these became infected. The remaining forty-one wounds were sutured up to the drains and three or 7.3 per cent of these became infected. In the three instances in which the peritoneum was closed and the wound packed open

with vaseline gauze no infections occurred. There were two or 4.1 per cent infections in the forty-eight patients drained only to the peritoneum. In the undrained operations there were eight or 4.0 per cent of infections. This would seem to show that if drainage is indicated at all, the wounds should not be sutured if infection is to be avoided.

As would be expected, all of the seventy cases having generalized peritonitis were drained. Except for suturing the peritoneum the wounds were left open forty-nine times or in 70 per cent of these cases.

In the abscess group penrose drains were used in thirty-four, cigarette drains in three, Mikulicz drains in two, rubber tissue in two, gauze packing three times and vaseline gauze twice. In two instances no drain was used. In the first instance, at operation while the distal portion of the appendix had been absorbed, the proximal stump was still acutely inflamed but there was no free pus and so no drainage was used. In the second instance, the appendix with a portion of adherent omentum was removed. After the operation, when the omentum was separated from the specimen, an abscess was found between the appendix and adherent omentum. The wound, except for peritoneum, was left open in thirty or 66.6 per cent of those cases in which drains were employed.

In this group three or 6.4 per cent developed retention of pus in the wound. In all three the wounds were sutured up to the drains and in one instance a cecostomy was done.

In the group with abscess the appendix was not removed at the time of the first operation in three cases and was only partially removed in two cases.

Also in this group cecostomy was performed at operation in three instances, appendecostomy once and ileostomy once.

Cultures were reported fifty-nine times in the unruptured group. In forty-six or 78 per cent of those reported there was no growth. In seven or 12 per cent *Bacillus coli communis* was reported. *Staphylo-*

coccus aureus was reported twice and *Bacillus coli* with *anterococcus viridans*, *Staphylococcus albus*, *Bacillus coli* with *Staphylococcus albus* and an atypical Gram-negative bacillus each appeared once.

TABLE V  
BACTERIOLOGY

	Unrup- tured	Spread- ing Peri- tonitis	Ab- scess	Total
Reported.....	59	55	30	144
No growth.....	46	11	7	64
<i>Bacilli coli communis</i> ..	7	38	17	62
<i>Bacillus coli</i> and one other organism.....	2	2	4	8
All others.....	4	4	2	10

In the group with spreading peritonitis there were fifty-five cultures reported. Of these, no growth was reported eleven times or in 20 per cent. *Bacillus coli communis* occurred thirty-eight times or in 69 per cent of those cultures reported. There was one each of a Gram bacillus with *anterococcus viridans*, *Bacillus coli* with *Staphylococcus aureus*, *Staphylococcus albus*, *Bacillus coli* with *enterococcus viridans* and *Bacillus proteus* with *Streptococcus hemolyticus*.

In the abscess group thirty cultures were reported. In seven or 23 per cent of these there was no growth. *Bacillus coli communis* appeared seventeen times or in 56 per cent of the cases. *Bacillus coli* with *enterococcus viridans* occurred three times and the following appeared once each: a Gram-negative bacillus with *enterococcus viridans*, *Bacillus coli* with *Staphylococcus aureus* and *Bacillus lactis aerogenes*.

**Complications.** The principal local complications were abscess of the abdominal wall which occurred seventeen times, intra-abdominal and pelvic abscesses, each of which occurred seven times and paralytic ileus which occurred nine times. The outstanding general complications were in the respiratory group. Lobar pneumonia occurred six times, bronchopneumonia seven times, acute bronchitis four times, atelec-

tasis three times and pulmonary embolus occurred once.

The following table lists the complications as they appeared in the three groups:

TABLE VI

Complication	Unrup- tured	Peri- tonitis	Abscess
Evisceration.....	..	1	2
Ileus.....	..	7	2
Lobar pneumonia.....	2	2	2
Bronchopneumonia.....	5	2	
Atelectasis.....	2	1	
Acute bronchitis.....	3	1	
Pulmonary embolus.....	..	1	
Pulmonary infarct.....	1		
Intra-abdominal abscess....	2	4	1
Pelvic abscess.....	..	6	1
Fecal fistula.....	1	5	5
Convulsion at operation....	..	1	
Persistent fistula.....	..	..	1
Thrombophlebitis of portal vein.....	..	..	1
Saphenous phlebitis.....	..	..	1
Abscess of wound.....	13	1	3
Drain.....	5		
No drain.....	8		

A diagnosis of intra-abdominal abscess was made in two patients in the unruptured group. In one instance the abscess opened spontaneously through the operative wound. In the second case a secondary exploration was done but the abscess could not be found. In the spreading peritonitis group six cases were classified as pelvic abscess, one of which was opened through the rectum. The others were not operated upon. Four were classified as intra-abdominal and none were operated upon. In the abscess group one pelvic and one intra-abdominal abscess were recognized and in neither instance was operation performed.

Fecal fistula occurred once in the unruptured group and this healed spontaneously. There were five fecal fistulas in each of the other two groups. In each group four healed spontaneously and the remaining one was present at the time of the death of the patient.

There were fourteen deaths or an incidence of 3.3 per cent in the entire series. No

death occurred in the 300 unruptured cases. There were ten deaths out of seventy or an incidence of 14.2 per cent in the group with spreading peritonitis and four out of forty-seven or an incidence of 8.5 per cent in the group with abscess.

TABLE VII  
DEATHS

	No. Cases	No. Deaths	Per Cent
Without perforation	300	0	0 0
Spreading peritonitis	70	10	14 2
Abscess	47	4	8 5
Total	417	14	3 3

The following shows the decade of life in which death occurred:

TABLE VIII

	0- 10	11- 20	21- 30	31- 40	41- 50	51- 60	61- 70
Spreading peritonitis		3		4		1	2
Abscess	1			1	1	1	
Total	1	3		5	1	2	2

In the general peritonitis group the average time between the onset of symptoms and admission to the hospital was 45.2 hours as against the average of 61.5 hours in the ten cases in which death occurred. The same holds true of the abscess group in which the average time between onset of symptoms and admission was 91.8 hours and the average time of the group of four who died was 97.5 hours. This again emphasizes the well known fact that delay in entering the hospital is a factor which increases the mortality in acute appendicitis.

In eleven deaths out of fourteen the cause of death was primarily due to general peritonitis alone. In one instance the death was caused by an associated pelvic abscess, fecal fistula and lobar pneumonia; in

another patient thrombophlebitis of the portal and mesenteric veins was the immediate cause of death. Massive pulmonary embolus accounted for one death.

The following is an analysis of the deaths in the group with rupture and spreading peritonitis:

CASE No. 781. A fourteen-year old, white female had been ill thirty-six hours and was operated upon one and one-half hours after admission. A McBurney incision was used, appendectomy was performed and two penrose tubes left in place. All layers of the wound except the peritoneum were left unsutured. Postoperatively, she vomited, had distention and developed an adynamic ileus. She died on the sixth postoperative day. Autopsy diagnosis: (1) Acute fibrinopurulent peritonitis; (2) acute aerofibrinopurulent migratory pleuritis, bilateral; (3) patch atelectasis of left lower lobe and right lower lobe; (4) severe degeneration of liver; (5) acute perisplenitis, and (6) acute periophorosalpingitis, bilateral.

CASE No. 2228. A fourteen-year old, white male had been ill seventy-two hours and was operated upon four and one-half hours after admission. The McBurney incision was used, appendectomy performed and two penrose tubes were placed. All layers of the wound except the peritoneum were left unsutured. The postoperative course was stormy. He developed a pelvic abscess which was drained per rectum. He also had an abscess of the left groin which was opened. There was a fecal fistula which drained from this wound and also from the original incision. Terminally, he developed a left lobar pneumonia. He died on the forty-first postoperative day of generalized peritonitis, pelvic abscess, fecal fistula and left lower lobe pneumonia. No autopsy was performed.

CASE No. 3621. A fifty-one-year old, white male had been ill fifty hours and was operated upon two hours after admission. A McBurney incision was used. Appendectomy was done and two penrose tubes were placed. Postoperatively, he had distention and other signs of generalized peritonitis. On the fourth postoperative day he developed right lower lobar pneumonia and he died on the tenth postoperative day. The cause of death was general peritonitis and right lower lobe pneumonia. No autopsy was performed.

CASE No. 2765. A thirty-four-year old, white female who had been ill for seventy-two hours, was operated upon two hours after admission. A right rectus incision was used. The appendix was removed and two penrose tubes inserted. The peritoneum alone was sutured. The postoperative course was marked by high fever, distention and vomiting. Death occurred on the third postoperative day. Autopsy diagnosis: (1) Acute diffuse fibrinopurulent peritonitis with ileus; (2) hemorrhagic pulmonary edema, and (3) fatty change of liver.

CASE No. 591. A thirty-four-year old, white male who had been ill twenty-eight hours, was operated upon five hours after admission. A ruptured appendix was removed through a McBurney incision and a penrose drain was inserted. The peritoneum only was sutured. His postoperative course was smooth, when suddenly on the ninth postoperative day he died. The autopsy diagnosis stated there was acute localized fibrinopurulent peritonitis and massive pulmonary embolism.

CASE No. 225. A thirty-five-year old, white male had been ill ten days and was operated upon ten hours after admission. The preoperative diagnosis was perforated peptic ulcer and a transverse incision was made. When the perforated appendix was found the incision was extended downward and the appendix removed. Penrose drains were placed in the lower angle of the wound and the remainder of the wound closed. Postoperatively, he had a spiking temperature, chills, distention and paralytic ileus. On the seventh postoperative day the drains were removed and feces and pus were evacuated from the wound. He died on the seventh postoperative day of general peritonitis and fecal fistula. No autopsy was performed.

CASE No. 2755. A sixty-nine-year old, white male had been ill eighteen hours. His symptoms were thought to be due to an incarcerated right inguinal hernia and a sore throat. Three days after admission his hernia was operated upon and when peritonitis was found, a right rectus incision was made and appendectomy performed. Drainage was by means of two penrose tubes through a stab wound. He had adynamic ileus postoperatively and died on the first day after operation. The cause of death was general peritonitis and uremia? No autopsy was performed.

CASE No. 2310. A thirty-six-year old, white male had been ill fifteen hours and was oper-

ated upon two hours after admission. Appendectomy was performed through a McBurney incision and one penrose tube was placed. The incision was closed up to the drains. Following operation he sustained a high temperature with a sharp rise on the fourth and fifth postoperative days. He had vomiting, distention, and developed adynamic ileus and died on the seventh day after operation. The cause of death was generalized peritonitis. No autopsy was performed.

CASE No. 4144. A sixty-three-year old, white male had had numerous gallbladder attacks prior to admission. The attack of abdominal pain before admission began about twelve hours previously and he was operated upon five hours after admission. Believing he had acute cholecystitis or a ruptured gallbladder, a right upper rectus incision was made and thick greenish fluid was encountered. The gallbladder was thickened and edematous and filled with stones. Cholecystectomy and choledochotomy was done. The appendix was then found to be ruptured and a McBurney incision was made, appendectomy performed and penrose drains placed through the McBurney incision and the wound left open. The patient died the day following operation. The cause of death was generalized peritonitis. No autopsy was performed.

CASE No. 4136. A seventeen-year old, white female had been ill seventy-two hours and was operated upon two and one-half hours after admission. Appendectomy was performed through a McBurney incision, two penrose drains were placed and the wound left open. Death occurred on the first postoperative day. The cause of death was generalized peritonitis. No autopsy was performed.

The following is an analysis of the deaths in the group with abscess:

CASE No. 2596. A thirty-one-year old, white male had been ill forty-eight hours and was operated upon three hours after admission. A McBurney incision was used. At operation the appendix ruptured during removal. Appendectomy was performed and two penrose drains were left in place. He took anesthesia badly and once he stopped breathing. While still under the anesthetic he had a convulsion which at the time was thought to be due to chronic alcoholism. He developed adynamic ileus postoperatively. On the third postoperative day he had another convulsion and later

that day he died. The cause of death was generalized peritonitis and convulsions. No autopsy was performed.

CASE No. 3998. A fifty-eight-year old, white male had been ill two weeks and was operated upon seven hours after admission. Appendectomy was performed through a right rectus incision. The appendix was friable and during removal there was bleeding, presumably from the appendicular artery, which could not be controlled by clamping. A gauze packing was therefore placed at the appendix site and three rubber dam drains were used. There was distention following operation and on the second postoperative day he eviscerated. The intestines were replaced with gauze packing. The temperature ranged from 102 to 103.5°F. for seven days. Distention continued and he developed adynamic ileus. He died on the eighth postoperative day. The cause of death was evisceration and generalized peritonitis. No autopsy was performed.

CASE No. 3384. A forty-seven-year old, white male had been ill thirty hours and was operated upon eight hours after admission. Appendectomy was performed through a McBurney incision, two cigarette drains were used and the wound, except for the peritoneum, was unsutured. The postoperative course was stormy. He had a spiking temperature from the start, a partial evisceration and later a fecal fistula. He became jaundiced and a secondary operation for possible subdiaphragmatic or hepatic abscess was done and none was found. He died on the twenty-seventh postoperative day. Autopsy diagnosis was thrombophlebitis of the portal and mesenteric veins, hepatitis, icterus, acute diffuse peritonitis, bilateral pleuritis and splenitis, fecal fistula and purpura.

CASE No. 4249. A ten-year old, Chinese

male had been ill twenty-four hours and was operated upon four hours after admission. Appendectomy was performed through a McBurney incision. Two penrose drains were placed and except for the peritoneum, the wound was not sutured. His postoperative course was marked by high temperature, vomiting and distention and he developed adynamic ileus. He died on the sixth postoperative day of generalized peritonitis.

#### SUMMARY

A statistical analysis of 417 consecutive cases of proved acute appendicitis is made.

The distribution in sex, color and age groups is stated.

An outline of the usual method of treatment is given.

The signs, symptoms, temperature, pulse, respiration, duration of symptoms and use of cathartics are analyzed.

At operation the McBurney incision is used almost exclusively when the diagnosis is certain. When drainage is employed, the tendency is to suture the peritoneum only.

Wound infections, bacteriology and complications are presented.

There were fourteen deaths or an incidence of 3.3 per cent in the entire series. There were no deaths in 300 unruptured cases; ten deaths out of seventy or an incidence of 14.2 per cent in the group with spreading peritonitis and four out of forty-seven or an incidence of 8.5 per cent in the group with abscess.

A brief report of each case in which death occurred is given.



# SURGICAL IMPORTANCE OF THE ABERRANT RENAL VESSEL IN INFANTS AND CHILDREN\*

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THE association of aberrant renal vessels with hydronephrosis has long been known. Boogard<sup>1</sup> first described the kinking of a ureter around an anomalous vessel in 1857. Since that time more than 500 cases have been reported by various authors. No unanimity of opinion exists in regard to the exact rôle played by the aberrant renal vessel in this type of hydronephrosis. There is also no complete agreement in regard to the proper surgical management of a patient with this condition.

In reviewing thirty cases of hydronephrosis associated with aberrant renal vessels in which the patients were operated upon at the Boston Children's Hospital, it is our hope that interesting light will be cast on the etiologic rôle played by the aberrant renal vessel, and that the evaluation of results following conservative surgery will influence the future care of such patients. It is our purpose to compare this condition in children with adults, since as far as we know, a series of infants and children as large as this has never been reported. The majority of patients in this study were operated upon by Dr. William E. Ladd and Dr. Thomas H. Lanman.

*Etiology.* There has been considerable controversy in the literature as to what rôle, if any, the aberrant renal vessel plays in the production of hydronephrosis. Some writers suggest that the aberrant renal vessel acts simply as an aggravating factor coming into play only after the hydronephrosis has been initiated by abnormal

kidney mobility, trauma, inflammation with scar tissue, unrecognized ureteral stenosis or extrarenal pelves. They point out the frequency with which aberrant renal vessels are present without an accompanying hydronephrosis. Other writers believe that the aberrant renal vessel must at least play a rôle in the *continuance* of the hydronephrosis if simple division of these vessels effects a cure. Still another group of investigators led by Quinby,<sup>2</sup> Pierson and Barney,<sup>3</sup> Walters<sup>4</sup> and Cecil<sup>5</sup> believe that the hydronephrosis is primarily caused by the aberrant renal vessel, either by offering mechanical obstruction to proper ureteral drainage or by inhibiting ureteral peristalsis by pulsation on the adjacent ureter. Quinby<sup>6</sup> criticizes the importance placed on ptosis. He points out that with the descent of an abnormally mobile kidney, it is not only the organ itself which moves but the blood vessels move with it as a whole. In a typical case of movable kidney, the mobility takes place on the vascular pedicle as a centrally fixed point and the peripheral ends of the vessels move with the organ itself. It is hard to see, he writes, how one portion can be assumed to move while another intrinsic structure remains behind. Quinby<sup>6</sup> has produced experimental hydronephrosis by simply tying a loose thread about a ureter.

In each of our thirty cases operation revealed aberrant renal vessels of such size and in such close relation to the ureter that there was no question in the operator's mind but that they were a definite cause of

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obstruction. In each case the renal pelvis of the affected kidney appeared moderately or markedly dilated. Except in those few patients in whom nephrectomy had to be performed, the pelvis was noted to decrease markedly in size when the aberrant renal vessels were divided. Although ptosis, fibrous adhesions and ureteral stricture have been such a common accompaniment in adult patients that they have been regarded by some authors to be the primary etiologic factor causing the hydronephrosis, it is interesting to note that in our young age group ptosis was present in only one case, fibrous bands in only two, and intrinsic ureteral stricture in only four. Whenever a stricture was found, there was an artery crossing the ureter at the point of stricture. This observation suggests that a pulsating aberrant artery may be a factor in eventual scarring and stricture of an adjacent ureter. However, it is possible to have intrinsic stricture of the ureter without aberrant renal vessels so that such vessels are not necessarily the only cause of this ureteral stricture. The fact that ptosis, fibrous bands and intrinsic ureteral stricture are so rarely encountered in young patients with this type of hydronephrosis has led us to believe that the aberrant renal vessel itself is the essential etiological factor in the obstruction. Also, that any accompanying pathological lesion which may be present, such as ptosis, bands, kinks or stricture is more apt to be a secondary change and, therefore, more prevalent in adult life.

*Incidence.* In a review of 1,000 consecutive unrestricted autopsy protocols from the Pathology Department of The Children's Hospital, aberrant renal vessels to the inferior kidney poles were noted in 3.8 per cent. All individuals in this series were under twelve years of age. In only one subject was hydronephrosis present. Despite this apparent low incidence we believe hydronephrosis associated with the aberrant renal vessel to be more common in infants and children than is generally supposed. Although only twenty-seven of

the 500 cases reviewed by us in the literature were specifically stated to be under twelve years of age, all of the thirty patients in the present report were within this age limit. Twenty-four of these young patients have been encountered during the last eight years. The increasing incidence of this lesion in our experience must be attributed to the growing realization that ureteropelvic obstruction in children is not uncommon and that early diagnosis of this condition in young patients is not difficult.

*Age, Side and Sex.* Most authors place the age of onset of this type of hydronephrosis between ten and sixty years. In The Children's Hospital series the age of onset of symptoms was about equally distributed in the different years—from birth to twelve years. One of our patients was operated upon at three months of age, another at ten months of age, showing that this condition may give symptoms very early in life. Most authors report that the condition more often involves the right kidney than the left and that it occurs more often in males than in females. In this series the right side was involved in twelve cases and the left in seventeen. Bilateral aberrant renal vessels were found in only one case. There were fourteen males and sixteen females.

*Symptoms and Signs.* The long duration of symptoms has been emphasized in adults. This also appears to be true in infants and children. The symptoms frequently suggest disturbances of the gastrointestinal tract rather than of the urinary system. The complaints may appear spasmodically with long periods of remission. Pain is one of the commonest symptoms, being present in twenty-four of our thirty cases. It most often occurs in the region of the affected kidney but it may be referred to the lower quadrant. It usually occurs in periodic attacks with free intervals lasting days or months. The pain may be vague or sharp and intense, lasting from a few seconds to one or two days. A few patients are left with a heavy residual soreness after the attack is over.

Gastrointestinal symptoms were present in twenty-five of our thirty cases. In six of these there were no signs or symptoms which directed the physician's attention to the genitourinary tract. Vomiting was noted in eighteen, abdominal pain (not flank) in sixteen, anorexia in ten and nausea in ten. Fatigue, weakness and headache were occasional complaints.

In a large majority of our cases (twenty-six) the temperature on admission to the hospital was 100°F. or below. Three patients had a temperature between 101° and 104°F., and one patient with considerable renal infection was admitted with a temperature of 105°F. Fever is rare in the uninfected case.

The various genitourinary signs noted in order of frequency were: pyuria twenty-two; hematuria nine; albuminuria eight; frequency five; dysuria four; enuresis three; burning urination one, and urgency one. In twenty-two patients with pyuria, eleven showed only a few white blood cells, and eleven showed the urine loaded with white blood cells. In seven patients the urine examination was entirely negative. From these observations in infants and children, it appears that one or more genitourinary signs, accompanied by abdominal pain, or vague gastrointestinal symptoms, is the most constant finding in cases of hydronephrosis caused by aberrant renal vessels. Yet too much emphasis has been placed in the past on negative or equivocal urinary findings. *It is only by early diagnosis, before renal infection becomes established, that conservative surgery may be expected to give the highest percentage of good results.*

The physical examination of patients with aberrant renal vessels may show no abnormal findings. In only eight of our thirty young patients was a palpable mass noted in the kidney region.

**Laboratory Findings.** The white blood count was within normal limits in eleven and elevated 10,000 to 20,000 in eighteen. The blood non-protein-nitrogen was studied in twenty-five patients: It was normal in twenty, slightly elevated in four

and raised to 46 mg. per cent in one. Phenolsulfonphthalein excretion (intravenous route) was studied in nineteen patients. An excretion of over 60 per cent in two hours was found in nine, and an excretion under 60 per cent was observed in ten. No patient had an excretion of less than 45 mg. per cent in two hours. Urine culture was studied in twenty-five patients. In eleven of these, the urine showed no growth. Colon bacillus was the commonest organism found in those cases with positive cultures. The above laboratory data were found to be of no value in estimating the amount of permanent kidney damage present before operation. Some of these patients with the best clinical results following conservative surgery were noted to have as discouraging laboratory findings prior to operation as those patients who required nephrectomy.

**Diagnosis.** Prompt recognition of this cause of hydronephrosis during infancy and childhood offers the best hope of reducing the distressing number of nephrectomies reported in order age groups. The long duration of symptoms and the advanced renal destruction so frequently found in adults can often be avoided by detecting and treating the condition in childhood. The present series of cases indicates that it is possible to recognize this lesion in young patients.

In some of our patients the correct diagnosis was not made until after a considerable lapse of time (as long as eight years in one child). This delay was caused by failure to realize that hydronephrosis could exist with predominant gastrointestinal complaints and with negative or equivocal urinary findings. Most victims of delayed diagnosis were regarded casually as having abdominal pain of unknown etiology, recurrent or chronic pyelitis, or chronic pyelonephritis.

Intravenous pyelography suggests or confirms the diagnosis in most instances. Twenty-nine of our thirty patients eventually received either intravenous, retrograde or intravenous and retrograde urographic study. Of twenty-two patients given in-

travenous pyelograms the correct diagnosis was suggested in all but two cases. Twenty-three patients were studied by retrograde pyelography. In all but two of these (in which additional congenital anomalies were present) a diagnosis of ureteropelvic obstruction was immediately made. The correct diagnosis following x-ray study is, therefore, evident in most cases.

Any patient presenting repeated unexplained gastrointestinal complaints, especially when accompanied by one or more urinary signs, or any patient with pyuria which does not respond to carefully planned medical therapy within four or five weeks should be investigated by intravenous pyelography. With the realization that the obstructing aberrant renal vessel is not uncommon in infants and children and with the aid of improved excretory urography, we have greatly increased our percentage of early diagnosis. Although in a large proportion of patients with vague or equivocal clinical findings the urinary tract may be normal, urographic studies must be done if early diagnosis are to be made. Intravenous (or excretory) urography is the most conservative roentgenological approach to these problems, and should in most instances precede retrograde studies. Our present method of intravenous urography has been recently reviewed by one of us.<sup>7</sup> Careful preparation of the patient is essential in order to avoid confusing gas shadows in the intestines. In children, many of these shadows are actually due to swallowed air which passes from the stomach into the small intestine, and can best be avoided by maintaining the patient in such a position that swallowed air may be passed back through the esophagus rather than on through the pylorus. Since most children swallow air when they cry, the contrast material is injected with the patient held prone or on the right side, and the patient then placed upright until the first film is taken five minutes after the injection. During the intervals between films, the patient is kept in the prone position. A preliminary film of the urinary tract is always taken and

inspected before the injection of contrast material. If the urinary tract is seen to be obscured by gas or feces in the colon, evacuation may be promoted by the use of pitressin. In our experience pitressin is not effective in elimination of gas from the small intestine, nor are enemas effective in elimination of gas from the colon. The use of pitressin is contraindicated if intestinal obstruction or hypertension is present. The blood pressure should always be taken, even in infants, before pitressin is given. Diodrast (35 per cent solution) is used as the contrast medium in dosages varying from 10 cc. for patients under six months to 25 cc. for patients five years or older. These relatively large doses have been found necessary for satisfactory delineation of the urinary tract. The use of diodrast is contraindicated when uremia or severe liver damage is present. Caution should be exercised in its administration if there is a history of allergy.

Films of the urinary tract are routinely taken at five, fifteen and thirty-minute intervals following the injection. Each film, however, is immediately developed and inspected in order that oblique or lateral views may be taken if indicated. Since drainage of the kidney pelvis is significant, delayed interval films are taken one to four hours after the injection to estimate the degree of retention in those patients who show changes suggesting obstruction on the routine films. Only by considering each patient as an individual problem, and by conducting each examination step by step as a serial study is the greatest value obtained from excretory urography. (Fig. 1.)

Cystoscopy with retrograde pyelography is recommended when abnormal findings are detected by intravenous studies or when satisfactory visualization is not obtained by excretory urography. In our experience cystoscopy can be performed in all patients over one year of age and frequently can be carried out in patients under one year of age. General anesthesia is used in most patients. Care must be taken to insert the catheter tip above the

ureteropelvic junction into the renal pelvis. With the patient in the Trendelenburg position, the contrast media (sodium iodide

ureteropelvic junction. In the absence of obstruction, the dye usually flows back along the ureteral catheter from the pelvis.



FIG. 1. E. P., age five years. Urographic delineation of changes produced by an aberrant renal vessel. A, routine excretory urogram taken thirty minutes after intravenous injection of diodrast. The left kidney calyces are markedly dilated. The contrast medium has not yet reached the renal pelvis. B, film taken thirty minutes after A, (sixty minutes after intravenous injection of diodrast). At this time, the kidney pelvis is also filled with diodrast and is moderately enlarged and bulbous. The upper end of the ureter is not seen. C, retrograde urogram with the tip of the ureteral catheter in the lower portion of the ureter. The ureter is well visualized and appears normal, except for obstruction at its upper end. Only a small amount of contrast medium has passed into the renal pelvis and calyces. The position of the catheter tip has a great deal of influence on the picture seen in the retrograde urogram. (See Figure 4 for retrograde urogram injected with the tip of the ureteral catheter in the renal pelvis.)

(12 per cent) or diodrast) is instilled through the ureteral catheter and x-ray films are taken. (Fig. 4 B.) The catheter tip is then withdrawn until it lies below the ureteropelvic junction. The injection and x-ray films are repeated. (Fig. 1 C.) The patient is then placed in an upright position and a five-minute interval film is taken in order to determine the rapidity with which the kidney pelvis empties. We have noted in cases of ureteropelvic obstruction that when the catheter tip is within the kidney pelvis, the contrast media outlines the dilated pelvis and ends abruptly at the

We have had an insufficient number of cases performed in this manner, however, to be certain of this sign.

*Treatment.* There has been a considerable difference of opinion expressed in the literature in regard to the proper surgical management of patients with aberrant renal vessels. Although many authors within the last few years have advocated conservative surgery whenever possible, the number of nephrectomies performed has remained exceedingly high. Campbell's<sup>8</sup> series of eighteen cases in childhood with nephrectomy in ten shows that this has

been true even in the young age groups. Members of the conservative school have described various plastic procedures upon

adults. For these reasons, we believe that nephrectomy should rarely be necessary in young patients.

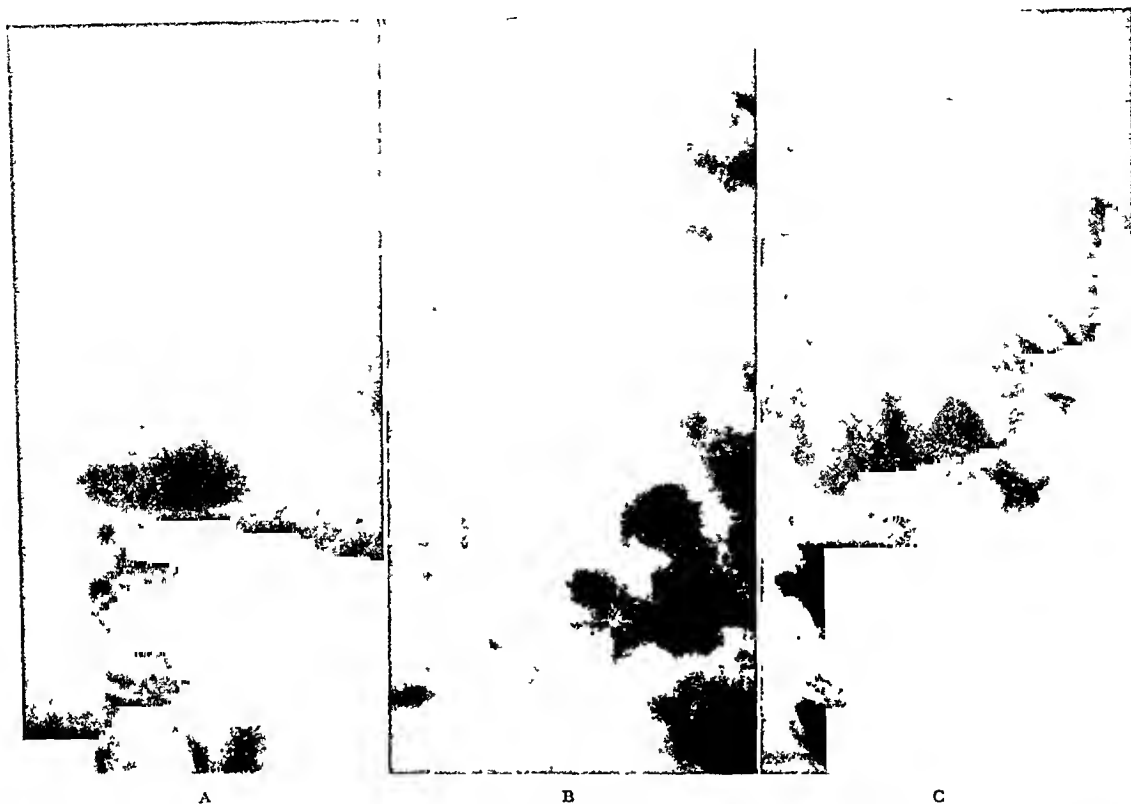


FIG. 2. T. G., age seven and one-half years. Urographic evidence of satisfactory result following simple ligation and division of an aberrant renal vessel. A, preoperative excretory urogram taken twenty minutes after intravenous injection of diodrast. The left kidney calices are markedly enlarged and blunted. The contrast medium has not reached the kidney pelvis. B, twenty-minute excretory urogram two weeks following simple ligation and division of an aberrant renal vessel. There is no change in the size or shape of the renal calices since A. The renal pelvis and upper end of the ureter are filled with contrast medium. Too short a time has elapsed since operation to permit evaluation of the operative results. C, thirty-minute excretory urogram, seven years after operation. The renal pelvis now appears normal. The calices are markedly improved although slight blunting persists.

the kidney pelvis and ureter. Each suggested procedure has received its share of criticism.

At the Boston Children's Hospital, the surgical service has consistently urged conservative therapy whenever possible. It has seemed likely to us that infants and children are less apt to have such marked parenchymal destruction as is seen in adult cases in which the pathological process has slowly progressed for years. More complete anatomic restoration following conservative surgery has also seemed more frequent in children than has been described in

Twenty-eight of our thirty patients were conservatively treated by ligation and division of the aberrant renal vessel. In sixteen patients no further operative steps were taken, but in the remaining twelve patients various additional procedures were indicated. Pyelotomy with exploration of the ureteropelvic junction was done in seven, nephropexy in one, plastic reconstruction of the pelvis in one, reimplantation of the ureter into the kidney pelvis in one and heminephrectomy in two. Primary nephrectomy was performed in only two individuals.

## DISCUSSION AND RESULTS

*Simple ligation and division of the aberrant renal vessel* has been the procedure of

studies. Two of the patients, who failed to have postoperative x-ray studies, are both asymptomatic seventeen years after operation. Although probably cured, they are

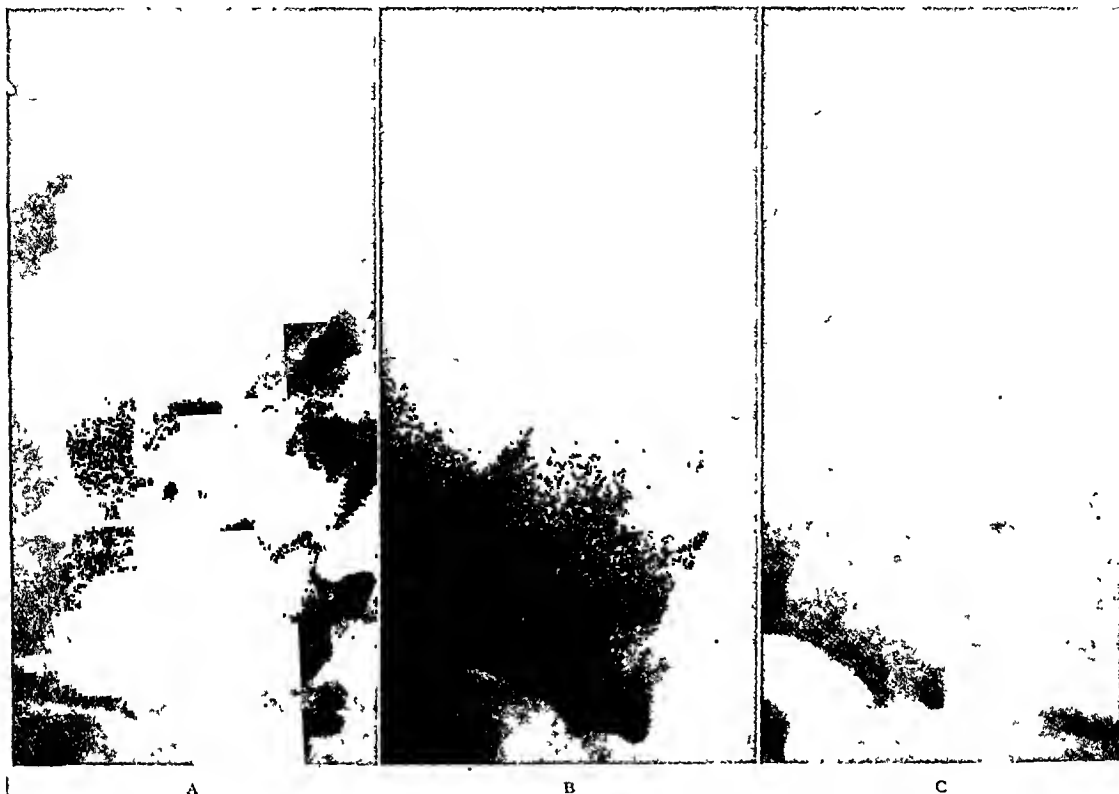


FIG. 3. H. D., age eleven years. Urographic evidence of fair result following simple ligation and division of an aberrant renal vessel. A, preoperative excretory urogram taken thirty minutes after intravenous injection of diodrast. The right kidney pelvis and calices are markedly dilated. No diodrast is seen below the ureteropelvic junction. B, thirty-minute excretory urogram, nine months after operation. The renal pelvis and calices are still slightly enlarged although much smaller than prior to operation. C, film taken thirty minutes after B, (60 minutes after injection of diodrast). The patient was allowed to sit up during this interval. The renal calices and pelvis are smaller indicating adequate drainage.

choice at the Boston Children's Hospital whenever possible. This operation was performed upon sixteen of our thirty patients. The average duration of symptoms was seventeen months. In each case the obstruction appeared to be relieved immediately and the dilated kidney pelvis promptly emptied. In most instances there was temporary discoloration of the kidney area supplied by the aberrant renal vessel. However, after a few minutes' observation adequate collateral circulation appeared established. All patients in this group were seen one month to seventeen years after operation. Fourteen patients were asymptomatic and presented negative urine

considered "incomplete follow-ups." Two patients, because of recurrent symptoms and progressive renal destruction, had to be subjected to secondary nephrectomy approximately two years after ligation and division of the aberrant renal vessel. They are now entirely well.

Postoperative excretory pyelograms were obtained in eleven patients in this group. The x-ray findings in six of these were essentially normal. (Fig. 2.) In three others, there was definite improvement with marked decrease in the size of the calices and pelves and with improved ureteropelvic drainage. (Fig. 3.) In the remaining two patients, already noted

above, nephrectomy had to be performed. (Fig. 4.) Postoperative x-ray studies frequently failed to show immediate anatomic

had to have secondary nephrectomy, all others were clinically cured. Of the eleven patients followed roentgenologically, six



FIG. 4 D. F., age three and one-half years. Urographic evidence of unsatisfactory result following simple ligation and division of an aberrant renal vessel. A, preoperative excretory urogram taken twenty minutes after intravenous injection of diodrast. Only two dilated calices are seen in the right renal area. (A delayed interval film one or two hours after injection of the diodrast might have demonstrated the structures shown in B.) B, preoperative retrograde urogram with the tip of the ureteral catheter in the kidney pelvis. The dilated renal calices and pelvis are well outlined. The upper end of the ureter is not filled with contrast medium due to the obstruction at the ureteropelvic junction. C, Twenty-minute excretory urogram, two years postoperatively. There is no evidence of improvement. (Because of persistent pyuria, the kidney was subsequently removed. Only two patients in the present series required late nephrectomy.)

restoration. However, progressive reduction in the size of the kidney pelvis and calices usually occurred during the first few months following operation. It is probable that a certain number of these hydro-nephrotic kidneys may never return entirely to normal. Nevertheless, if a patient is asymptomatic, has a normal urine and shows good ureteropelvic drainage by x-ray, it seems fair to consider the result satisfactory.

From our observations we conclude that of sixteen patients traced at varying intervals following simple ligation and division of an aberrant renal vessel, two

showed normal postoperative findings, three were satisfactorily improved, and two had been subjected to nephrectomy.

*Ligation and division of the aberrant renal vessel with pyelotomy and exploration of the ureteropelvic junction* was performed in seven of our thirty patients. The average duration of symptoms in this group was thirty-two months. Exploration of the ureteropelvic junction was carried out when at operation a ureteral kink or narrowing led the surgeon to suspect possible intrinsic obstruction. In each case the pelvis was opened and a small catheter was introduced into the ureter. In three of these

patients a definite intrinsic stricture was found and dilated; in four there was no evidence of intrinsic obstruction. This group was seen from two months to eight and one-half years postoperatively. One patient complained of nocturia one to two time nightly; all others were asymptomatic. One patient showed slight albuminuria; all others had negative urine examinations. Follow-up pyelograms were obtained on all but one of these seven patients. Roentgenologically, the three patients who had shown stricture were cured. Of these four patients in which no stricture was found, one was cured, one was incompletely followed and two were regarded as poor results. One of these poor results may be attributed to the presence of a horseshoe kidney; the other, however, showed no excretion of dye on the affected side.

Although pyelotomy with exploration of the ureteropelvic junction was performed in only seven patients in this series, we now believe that this procedure should be carried out in all patients with ureteropelvic obstruction.

*Ligation and division of the aberrant renal vessel and nephropexy* was performed in one patient. This patient had had symptoms for one month. Five months postoperatively the patient was asymptomatic and had a negative urine. Postoperative pyelograms were not obtainable.

*Ligation and division of the aberrant renal vessel with plastic reconstruction of the kidney pelvis* was carried out in one patient. This patient had symptoms for forty-eight months. He was asymptomatic and had a normal urine seven months postoperatively. Pyelograms at that time showed improvement with reduction of the kidney pelvis from six times the size of the normal opposite side with poor drainage to three times that of the normal side with fair drainage. With the passage of time further improvement is anticipated.

*Ligation and division of the aberrant renal vessel with reimplantation of the ureter into the kidney pelvis* was performed in one patient who had had symptoms for eight-

een months. This procedure was carried out because an S-shaped deformity of the ureter persisted after the aberrant renal vessel was ligated and divided. He was clinically and roentgenologically cured when last seen five years after operation.

*Ligation and division of the aberrant renal vessel with heminephrectomy* was carried out in two patients. These patients had had symptoms for eight and one-half months and twelve months, respectively. Heminephrectomy was done in both of these cases because of persistent cyanosis of the lower renal pole after ligation of the obstructing vessel. Both were asymptomatic one and one-twelfth and four and seven-twelfth years, respectively, after operation. One had a negative urine; the other showed occasional albuminuria. Roentgenologically, both were cured.

Primary nephrectomy was carried out in two patients. One patient had symptoms for twenty-four months before a diagnosis was made, the other for twenty-five days. In both there was such marked parenchymal destruction and huge dilation of the kidney pelvis that conservative surgery was deemed inadvisable. Both patients are now asymptomatic and have normal urine fourteen and one-half and two and one-half years postoperatively. Pyelograms in each case show a well functioning but hypertrophied kidney on the opposite side.

If we exclude seven patients in our series who had incomplete or no postoperative roentgenologic study, one patient who had a horseshoe kidney in addition to an aberrant renal blood supply, and two patients who had primary nephrectomy, we are left with twenty patients for evaluation following conservative surgery. Eighty-five per cent of these are considered satisfactory results.

#### SUMMARY AND CONCLUSIONS

The aberrant renal vessel is one of the most common causes of hydronephrosis during early life. The aberrant renal vessel itself is the primary etiologic factor responsible for this type of hydronephrosis, and

any accompanying pathological lesion present such a ptosis, bands, kinks or stricture is probably a secondary change and is, therefore, more prevalent in adult life.

One or more urinary signs accompanied by abdominal pain or vague gastrointestinal symptoms is the most constant picture presented in cases of hydronephrosis caused by an aberrant renal vessel.

Patients with vague gastrointestinal complaints or with a pyuria which fails to respond to medical therapy within four or five weeks should have intravenous pyelography. Subsequent retrograde studies are recommended when abnormal findings are detected by excretory urography.

The commonest cause for delayed diagnosis has been the tendency to regard these patients as victims of unexplained abdominal pain, recurrent or chronic pyelitis or chronic pyelonephritis. Early diagnosis, before renal infection becomes established, and early treatment are imperative if the

distressingly high percentage of nephrectomies reported in adults is to be avoided.

Conservative surgery is the treatment of choice for this condition in infants and children. With improved early diagnosis nephrectomy should rarely be necessary.

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# INTRA-ABDOMINAL ADHESIONS\*

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THE prevention or correction of intra-abdominal adhesions has been a problem to the conscientious surgeon. Although only a minority of patients on whom intra-abdominal operations are performed, develop disabling adhesions, yet it is important that all known means be applied for their prevention; for, once adhesions have formed in the abdominal cavity, few surgeons are adventurous enough to perform an operation with the definite purpose of correcting these adhesive abnormalities.

Since, in many cases, it is easier to prevent than to correct abnormal pathological processes, as in the case of intra-abdominal adhesions, the surgeon, in consonance with these requirements and in keeping with his training, primarily directs his efforts toward eliminating conditions which are conducive to adhesive formations, and, secondarily, attempts to eliminate them after they have formed.

A review of research protocols† indicates that intra-abdominal adhesions are normally formed in nature by the developmental fusion of two adjacent serosal surfaces which are held in close contact, with constant pressure, for a sufficient time for the endothelium to be destroyed and the subjacent tissues to be fused. The natural method of fusion is exemplified during the migration of the cecum across the abdominal cavity and downward into the right lower quadrant. After migration is completed, or if for any reason the progress of the migration is stopped, there is a gradual elimination of the two adjacent serosal surfaces, one on the cecum and the

other on the abdominal wall, and fusion occurs.

In some instances the fusion of the cecum and ascending colon to the abdominal wall is extensive and the appendix, which normally is freely movable, may become involved in the adhesive formations and become closely attached to the abdominal wall. Adhesions usually form along its external border or on the lateral surface of the meso-appendix and extend to the lateral abdominal wall.

Adhesive formations in any part of the abdominal cavity may become attenuated and stretched (usually in the lines of stress), so that they become cord-like, and exert traction and pull on the intra-abdominal organs.

Irrespective of where adhesions occur in the intra-abdominal cavity, the two formative factors which must be present are: (1) destruction of the endothelial layers of two approximated serosal surfaces; (2) approximation and intimate contact of adjacent denuded serosal surfaces, for a sufficient period of time to permit bridging connective adhesive tissue to form.

In my article on interperitoneal adhesions (*Am. J. Med. Sc.*, 160: 375, 1920) the necessity of the above two factors was emphasized. It was shown that if only one of two approximated serosal surfaces of an intestinal loop held in contact is denuded, adhesions will not form. If, however, two intact serosal surfaces are held in constant contact by a circular suture and a bacterial culture is introduced in the pocket which has been formed, or if a killed bacterial culture (*Bacillus coli*) is introduced into the pocket, a dense adhesive formation will result.

† BEHAN, R. J. Interperitoneal adhesions. *Am. J. Med. Sc.*, 160: 375, 1920.

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It is further interesting to note that full strength tincture of iodine applied to the serosa of the bowel did not consistently cause adhesive formations unless the area so irritated was held in fixed and stationary contact for a sufficient period of time with a similarly irritated serosal surface. For this reason, precaution would indicate that tincture of iodine should not be applied to serosal surfaces in the abdominal cavity.

During experimental work it became apparent that inflammation was the potent cause for adhesive formations in the abdominal cavity. If, however, the bowel retained its free movability and was stimulated into active peristalsis, and if distention was prevented so that two adjacent serosal structures were not held in immobile contact for a sufficient time, adhesions were uncommon.

From the evidence of experimental and clinical investigations, the following elements were regarded as important in the prevention of intra-abdominal adhesions:

1. Restriction of intimate contact (under pressure) of two adjacent serosal surfaces. This restriction is aided by:
  - (a) Gravitational separation of denuded serosal surfaces (abdominal loops, etc.) from each other
  - (b) Increased peristaltic activities
  - (c) Elimination of gastric and intestinal distention
2. Stimulation of the peristaltic mobility of the stomach and intestine (large and small)
3. Limitation of inflammatory exudation (in peritonitis)

Since the first objective in preventing adhesive formation is to keep the adjacent denuded surfaces from coming into intimate contact, the idea was formulated that a nonabsorbable, nonirritating lubricating substance, which would adhere to the serosal surfaces, would fulfill the necessary requirements for such an objective. A substance which would in time be absorbed was sought. This absorption, however, should not occur until a protective layer of endothelium has formed. Various trial

substances such as olive oil, mineral oil, vaseline, etc., were applied to the denuded serous surfaces but none proved successful in preventing adhesions. A reason for failure was attributed to the fact that these substances are of organic origin and, of themselves, are not absorbable and are of an irritating nature. They were discarded. A substance, organic (animal) in origin and nonirritating to the body structures and having, at the same time, good adhesive qualities, was sought. Lanolin was found to fulfill these requirements and 5 per cent boric acid (for its mild antiseptic value) was added to it. It was found that a paste of pure lanolin (95 per cent) and boric acid (5 per cent), applied to serosal surfaces had a tendency to restrict the adhesive formations. Experimentally, it was determined that if prior to its application, both the adjacent serosal surfaces had been painted with tincture of iodine and were held in contact by suturing, adhesions were inhibited. It was also shown that lanolin paste applied to an area of the bowel denuded of its serosa prevented adhesive formations.

The experimental inhibition of adhesive formations by the application of lanolin and boric paste, indicated its possible value as a preventative of adhesive formations in abdominal surgery. However, persistent inflammatory reactions involving the serosa, unfavorably affected the potency of the paste so that in these cases apparently it did not inhibit interperitoneal adhesions.

A trial application indicated its value. At first the paste was used only in patients in whom there was extensively denuded peritoneum. Gradually, extension of its use occurred until we began applying it routinely to all serosal surfaces which were denuded or irritated. From our experience we are convinced that the paste does inhibit adhesive peritoneal formations and that it is of great value even in those conditions in which two adjacent injured and denuded serosal surfaces of bowel are held in close contact for considerable

periods of time. If, however, a blood clot is attached to the adjacent immobile serosal surfaces and has become organized, fibrous tissue fibrils form in the clot and unite the two surfaces. The application of a paste of lanolin and boric acid apparently does not in such cases prevent adhesive formations; it does, however, inhibit the formation in those cases in which marked inflammation has not occurred and a fair degree of free bowel movement with active peristalsis is present.

*Clinical Value.* We found lanolin and boric acid paste, applied intra-abdominally to peritoneal surfaces which had been traumatized or denuded of their serosa, to be valuable in inhibiting intra-abdominal adhesive formations. Our experience is such that we believe the application of the paste merits a trial in all patients in whom, at operation, interperitoneal adhesions have been found and have been separated; also, we hold that it has proved valuable in those cases in which the surgeon's experiences would indicate that, judging from the conditions found at operation, adhesions will likely follow the operative interference.

*Technic for the Use of Lanolin and Boric Acid Paste.* After the abdomen has been opened, great care is taken not to traumatize the serosal surfaces. Separation of adhesions by sharp dissection is better than rubbing them free with a pledget of gauze. If there is extensive adhesive formation between the abdominal wall and the omentum, no attempt is made to dissect the omentum free. It is sectioned and both stumps are inverted—one stump into the proximal omentum and the other into the peritoneal surface of the abdominal wall. Should the adhesions be of a massive type, especially if omental adhesions occur in other areas, it is best to section them. The stumps of the proximal and distal segments are then inverted into pockets of sound omental tissue. If raw surfaces have been created on the parietal peritoneum, these are covered by approximating sutures; or if this cannot be done, they are covered with a free omental graft. The omentum, if

it is very long and has a tendency to fall back into the area from which it was freed from its extensive adhesions, is held away from the operated region by fixing it to the abdominal wall so that it cannot gravitate into the involved area and again come into contact with denuded surfaces.

After a careful inspection to determine if all bands and adhesive formations, which may exert a pull, drag upon or obstruct intra-abdominal structures, have been sectioned and all bleeding has been controlled, the serosal structures are mopped clean by light application of dry gauze and the lanolin paste is applied. This paste has been prepared and sterilized, and is kept in small round metal containers which have been placed in larger sterile containers which are also sealed and sterilized.

When using lanolin and boric acid paste, precaution must be taken so that the lanolin is as nearly pure as it is possible to obtain. Much of the lanolin on the market is contaminated and frequently its interperitoneal application causes marked reactions, i.e., an elevation of temperature and a high pulse rate. In some instances commercial lanolin contains proteins and these may, in susceptible patients, give rise to allergic reactions. The paste (before using) should be sterilized on three different days, each sterilizing period to be for one hour at a temperature of 240°F. Before using, the paste is heated until it is completely liquified and flows freely. It is important that water contamination be prevented. This sometimes happens if the water in the container in which the paste is heated before being used bubbles over into the paste. The paste is applied in a fluid form and fairly warm to the peritoneal surface. When it is applied in this manner, the excess moisture in the peritoneum is evaporated and the peritoneum is dried. The paste sticks very firmly to this dry surface. Since it will not adhere to a wet surface, it is very important that the peritoneum be dried before the paste is applied.

*Prophylaxis.* An important prophylactic measure against postoperative adhesive formations is, if possible, to arrange the viscera at the close of an intra-abdominal operation so that long and constant contact of adjacent denuded surfaces cannot occur. As a further precaution against the formation of adhesions, the position of the patient should be changed every hour after operation; that is, the patient should rest on the right side for one hour and then should be changed to the left side. If the adhesions have been on the right side of the abdominal cavity, the patient is kept for longer periods on her left side and vice versa. When adhesions have formed between the omentum and the lower abdominal or pelvic viscera, the foot of the bed, after operation, should be elevated to such a degree that the omentum and the involved bowel will gravitate into the upper part of the abdominal cavity.

Precision, care and gentleness in operative technic are important. It is also of value that in the closing of the abdominal incision the edges of the peritoneum be everted. Immediately following the operation, the peristaltic movements of the stomach and bowel are stimulated by prostigmine, one ampoule of which is given intramuscularly every fourth hour. Eserine salicylate, gr.  $\frac{1}{30}$ , has also been found useful. It is given every fourth hour until the intestinal distention has been relieved. These should alternate with each other every second hour. If the stomach should become dilated, gastric lavage and the insertion and retention of a Jutte or a Levin tube is necessary. If intestinal dilatation is severe and ileus is thought to exist, a Miller-Abbot tube is inserted and kept in place until active peristalsis occurs and the distention is relieved. A rectal tube should also be inserted on the least indication of colonic distention. Low enemas of milk and molasses, or of turpentine and glycerine may also be given after suitable intervals. I have also found that constant application of hot stupes (70 per cent alcohol—95 cc., and glycerine—5 cc.) to

the abdomen are of value in the relief of ileus. These stupes are kept hot by means of hot water bottles or electric heating pad. Many are apprehensive of using heating pads because of the danger of short circuiting due to the moist pads. This has been prevented by placing dry rubber sheeting between the pad and the wet stupes. After a few days the distention, as a rule, is relieved, the pulse becomes less rapid, the temperature drops and the patient is on the road to recovery.

*Results.* I have used lanolin and boric acid paste in two hundred ninety abdominal sections in which the principal pathological condition was intra-abdominal adhesions, and have noted no bad results. In fact, after its use the operated patients complain surprisingly little of abdominal pain, and those who had had a previous abdominal section and were able to compare their sensations with those experienced after the previous operation, were pleased with the greatly lessened pain which they experienced in the operation in which lanolin and boric acid had been used. Therefore, the *reduction of postoperative pain* is an additional reason for the use of the paste in suitable cases. I also find its application very beneficial in those patients who have adhesions around the cecum and the ascending colon, due either to a chronic appendicitis or to some congenital defect by which stasis of the cecum and ascending colon has resulted in perityphlitis and pericecal and pericolonic adhesive formations. I have also applied the paste in several patients in whom there was recurring interperitoneal adhesive formation. In such cases I have had gratifying absence of the symptoms for which the patient was operated. If, however, the pathological intra-abdominal lesion which was the original cause of the adhesive formations, is allowed to persist, adhesions will usually recur. Favorable results are contingent upon the removal of all inflammatory intra-abdominal foci.

I have been able to follow the results, from one to over twenty years after operation, of some 181 cases out of the 290 patients in whom adhesions were the only pathological formations present in the abdominal cavity at the time of operation. These cases are summarized as follows:

TABLE I

	No Cases	Im-proved	Free of Symptoms	Not Im-proved	Died
Omental (general)	2		2		
Omental (at hepatic flexure)	1		1		
Omentum to abdominal wall	44	10	31	1	2
Omentum to gallbladder	11	1	10		
Omentum to cecum	3		3		
Omentum to intestine	6	1	4	1	
Omentum to pelvic organs	2		2		
Omentum to suspensory ligament	1		1		
Omentum to liver	1		1		
Between gallbladder and intestine	3		3		
Between gallbladder and stomach	5	3	2		
Between gallbladder and cecum	4	2	2		
Between gallbladder and duodenum	2		2		
Between abdominal wall and colon	4	2	1		1
Between abdominal wall and cecum	6	1	3	1	1
Between cecum and ascending colon	3		3		
Between liver and adjacent organs	2		2		
Between sigmoid and broad ligament	1		1		
Between sigmoid and cecum	1	1			
Intestine to intestine	2		2		
Pelvic	13	4	9		
Paraduodenal	1	1			
Pericecal	7	1	6		
Pericholecic	3		3		
Pericholecystic and perigastrie to abdominal wall	2	2			
Cecal (general)	6	1	5		
Appendiceal	15	4	11		
Generalized (intra-abdominal)	30	3	26		1
	181	37	136	3	5

In large herniations, particularly those occurring in postoperative incisions in which there are extensive adhesions between the omentum, intestines, stomach, liver and abdominal wall, it was found that the dissection and separation of the adhesions, with the consequent pull and traction on the involved structures, was associated with considerable shock. This shock was all the more serious since most of these operations were prolonged and incidentally were, in many cases, associated with long and difficult anesthesia in a poor risk patient. In two patients who died there were extensive adhesions of the omentum to the intestines and the abdominal wall.

CASE 1. David Bankerd was operated upon December 22, 1923 and died December 28, 1923. Abdominal pain was present which began two or four years before the patient entered the hospital. A gastroenterostomy and appendectomy were supposed to have been done four years previously, and three years previously adhesions had been separated. He had no relief from the pain from either operation. He was supposed to have had an ulcer resected at the first operation. The pain was of a dull character and did not radiate, was located near the umbilicus and sometimes in the left back.

At operation the omentum was tightly adherent to the abdomen; the liver was adherent to the abdominal wall and also to the transverse colon; the stomach was closely held in this mass of tissue. A mass was found to be connected between the colon, or the stomach at least was adherent to it and the bowel.

The patient went along fairly normal for several days after operation and then suddenly developed a high temperature; the temperature was the first to go up, the pulse rate never became rapid although respirations did tend to increase in rapidity, being 30 to 36 at the time of death.

There was great variation in rapidity of pulse, respirations and in that of temperature. This patient undoubtedly had considerable amount of infection because on December 26, 1923 the red blood cells were 4,200,000, the white blood cells 20,400, the hemoglobin 75 per cent, the polymorphonuclears 80 per cent and the lymphocytes 20 per cent. However, though infection was present the patient was getting

Of the 181 patients, out of the 290 in whom intra-abdominal adhesions were found to be the principal if not the only pathological lesion, 136 were freed of the symptoms for which they were operated, thirty-seven were improved, two were not improved and five died.

In no case in which death followed operation, could the death be attributed to the intra-abdominal application of lanolin and boric acid paste.

along fairly well until six days following operation a hypodermoclysis of plain water was given by an intern. Ringer's solution had been ordered. Only gross ignorance and colossal stupidity could be blamed for this patient's death.

CASE II. Rev. Alphone Mayer was operated upon August 30, 1938 and died September 3, 1938. He had had attacks of pain in the abdomen, accompanied by vomiting for ten years (following gallbladder operation) which gradually grew worse. The last attack occurred three weeks before entering hospital and was very severe.

At operation the omentum was adherent to the abdominal wall and also adherent by a broad band of adhesions to the portion of the ascending colon underneath the bowel. There were also adhesions connecting the liver to the anterior abdominal wall.

This death seemed due to severe toxemia which was present before the operation.

In a third patient a cholecystectomy was performed. A gastromesenteric ileus was not recognized by the resident physician and death occurred.

In a fourth patient, irrespective of precautions, though care was exercised against physical and mental strain, the patient sat up in bed on the third postoperative day and suddenly died, evidently the result of an acute dilatation of the heart.

In the fifth case, adhesions were found between the intestines, abdominal wall, mesentery and pelvis. There was also present a bad cholecystitis. In this patient the gallbladder was drained. The patient did not improve, the circulatory system gradually failed and death occurred in one week.

In the above series of cases, there really was only one uncomplicated case in which adhesions were the only pathological find-

ing and death resulted. In this patient, death apparently was due to a gastromesenteric ileus. This is a fairly frequent complication after operation for extensive intra-abdominal adhesions and should be guarded against carefully.

#### SUMMARY

Intra-abdominal adhesions form when the serosa of two adjacent peritoneal surfaces are denuded and remain in contact for a sufficient time for an exudate to become organized and adherent to the two surfaces. Distention of bowel with pressure exerted continuously between two adjacent intra-abdominal visceral surfaces is an active means toward such a union.

The organic base lanolin was chosen as a means of separating the opposing serosal surfaces and as a preventative of adhesive formations because of its marked adhesive and nonirritating properties. Boric acid was used because it is not irritating and has a certain low antiseptic value.

Two hundred ninety patients, in whom adhesive formations were found to be the principal pathological change present in the abdomen, were treated; of these, it was possible in 181 cases to obtain reports (follow-up records) of from one to twenty years after operation. One hundred thirty-six of the 181 patients were entirely free of the symptoms for which they had been operated, thirty-seven were improved and three were not improved. The five deaths which had occurred in the 290 patients operated were not in any way contingent upon the use of the lanolin paste.

We are well satisfied that an ointment of lanolin (95 per cent) and boric acid (5 per cent) has proved of value in preventing intra-abdominal adhesions.



# PROCTOLOGIC POSTULATES FROM AN ANATOMIC STANDPOINT

## ARRANGEMENT OF ANORECTAL MUSCULATURE AS USEFUL SURGICAL LANDMARKS

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ALTHOUGH anatomy does not change, anatomic concepts may, and, when they do, the surgeon is first to be concerned. Now that recent discovery indicates that the anorectal musculature is arranged as a web, rather than as a series of muscular rings as has been long supposed, there are many inferences to be drawn in regard to the surgical drainage of anal infection.

The solution of problems relevant to the treatment of the clinical entities commonly termed hemorrhoids, fissure, ulcer, abscess, fistula, stricture, etc., demands two things: First, the recognition that these entities are various manifestations of infection of the anal glands; second, that their development is conditioned by the spacial relationship of these glands to the surrounding anorectal musculature with its enclosed tissue spaces. When these entities are looked upon as infections and when the arrangement of the surrounding tissues is recognized, appropriate methods of drainage may be instituted in a precise manner. This manner will be appropriate, precise and, indeed, effective because the operator who possesses this knowledge is the only one who can profit by the guidance of a number of morphological deviations of contour of the anorectum that should serve as indispensable surgical landmarks. The correlation of these factors of infection and anatomy will provide such a workable concept that the surgeon may make logical deductions as to the appropriate methods of treatment.

Although there is a wide recognition of the etiologic rôle of the anal glands in the

production of anal infection, and while most practitioners recognize that the above mentioned clinical entities arise from this source, we may expect unlimited controversy in this regard. Here, we are chiefly concerned with showing how these glands fit into the anatomic scheme when pathologic changes occur and demand repair. However, we may point out the fact that, starting with Morgagni, a succession of investigators have incriminated these glands as the provocative agents for the clinical entities.<sup>1,2,3</sup> Further amplification of this factor of infection must be deferred until we consider the arrangement of the anorectal musculature, the spaces in which these glands are situated and the paths to which their infection may gain access.

In order to gain a conception of the arrangement of the anorectal musculature, we must first examine the anatomic contributions that form our legacy from the past; secondly, we must make certain deductions from that biologic law which states that structure tends to adapt itself to function. In other words, we should attempt to corroborate and, if possible, harmonize the arbitrary, uncorrelated contributions of supposed anatomic facts with the blueprint specifications that constitute Nature's demand. More specifically, we should consider carefully whether our conception of the arrangement of the musculature is sufficiently comprehensive to account not only for a sphincteric rôle, but as a guardian of the pelvic outlet against the drag of gravity upon the abdominopelvic viscera. Is it adequate to withstand the assaults of intra-abdominal

stress and strain? To answer this question let us make brief surveys of the findings of the anatomist and the inferences of the anthropologist.

The common conception of the arrangement of the anorectal musculature is that of a series of muscular rings surrounding the termination of the intestinal tube. This concept was the culmination of anatomic contributions from the time of Galen<sup>4</sup> to the time of Holl.<sup>5</sup> Galen considered the anorectum essentially as a tube with a muscular ring surrounding it. Later investigators, by more precise methods of dissection and scrutiny, found that the "ring" had subdivisions. To these they assigned resounding terminology. Finally, the levator ani was found to have a definite rôle in sphincteric action. The various components of this structure were recognized as having definite spacial relation to and action upon the terminal portion of the bowel. But the essential point to remember is that the emphasis has always been placed upon the anorectal musculature as being subdivided into a horizontal series of rings. This is shown by the usual designation of the muscular components from below, and proceeding upward, as the subcutaneous, superficialis, profundus divisions of the external sphincter with the overlying levator with its puborectalis, pubococcygeus, illeococcygeus and ischiococcygeus divisions. Thus, we conceive that sphincteric components are dispersed about the rectum as a series of ascending transverse planes.

This is all partly true. The anorectal musculature is subdivided as enumerated above. Each one of these subdivisions can be recognized by dissection. Several of them are recognized, or should be recognized in the majority of rectal operations. But the description is incomplete because the conception of the arrangement of the anorectal musculature, as being essentially a "ring series," is neither plausible from a biologic standpoint nor is it true from an anatomic standpoint.

In the first place, the demand by Nature

for a strongly reinforced pelvic outlet cannot be reasonably satisfied by such a concept. To satisfy that demand there

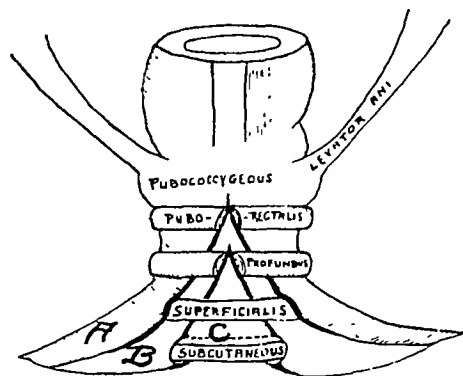


FIG. 1. Structural scheme of anorectal musculature. The inverted V-shaped sections show how sheaths of conjoined longitudinal muscle divide the external sphincter into its components and, thus, form a web. A, B and C, outer, middle, and inner sheaths, respectively.

must be a structure that binds, connects and reinforces the ring series. To accommodate the stress and strain of gravitational force upon the abdominopelvic viscera, a strongly interwoven web of musculo-fibrous tissue is necessary to protect the pelvic outlet. That is to say, there is an extraordinary need for a pelvic diaphragm. While it is true that the tilt of the pelvis allows considerable visceral weight to impinge on the posterior surface of the symphysis and ischial ramii, and also true that the curve of the sacrum and flexed coccyx serve as supportive factors, these do not suffice to abrogate the need for a muscular arrangement that possesses the greatest efficiency of design and pattern.

At this point it should occur to us that such muscular arrangement should follow the design and pattern of a web. If the muscular elements that enter into the composition of the pelvic diaphragm were so arranged as to form a tough, musculo-fibrous, sling-like, contractile, mesh or web we would have a structure that could reasonably conform to Nature's specifications for a supportive element. Such a web can be formed only by the presence of a structure that binds, connects, reinforces

the ring series and secures firm anchorage to the lesser pelvic brim. As a matter of fact, this structure exists and this arrangement prevails.

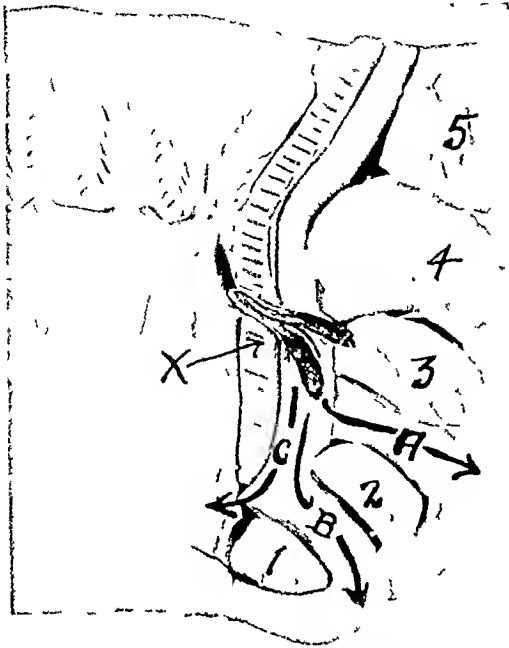


FIG. 2. Schematic model of section through anorectal wall indicates paths for extension of infection from branched tubular anal glands (x). 1, 2, 3, 4 and 5, Sphincters subcutaneous, superficialis, profundus, puborectalis, pubococcygeus, respectively. A, B and C, outer, middle and inner sheaths, respectively. Infection passing from glands along path c leads to ulcer; along B, to intrasphincteric fistula; along A, to infralevator abscess and extra-sphincteric fistula.

The fact that such a web-like arrangement exists not only corroborates the natural law that structure is subservient to function, but has practical surgical significance. However, before we consider the structure that is responsible for the web formation we should consider how it came about.

That the anorectal musculature is arranged in the form of a web is shown by a brief survey of anthropology. Evolution has been the primary factor in causing an intricate, web like arrangement of the anorectal musculature. As a result of the assumption of the upright posture, there was a strong demand for great reinforcement of the pelvic outlet. In order that the

pronograde anthropode could satisfy his ambition to become a biped, a great muscular reinforcement of the pelvic diaphragm was necessary to prevent prolapse of the

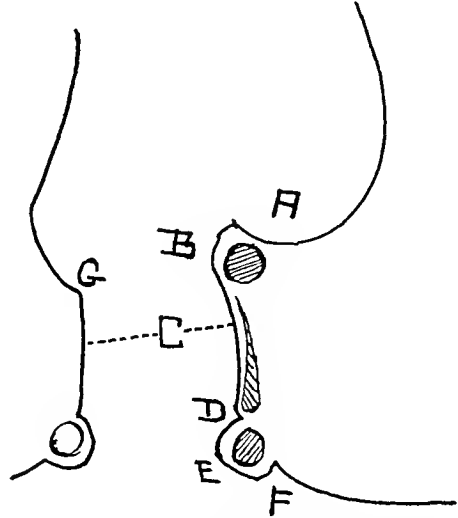


FIG. 3. Sketch of anal canal indicating surgical landmarks to be recognized by digital palpation. A, ampulla, B, puborectalis ledge; C, dentate level (one-half distance from B to D); D, internal intermuscular groove; E, subcutaneous ledge; F, external intermuscular groove; G, shelf of pubococcygeus.

pelvic viscera. Accompanying the shift of the stress of gravity from the ventral wall (as in the pronograde ape) to that of the perineal wall (as exemplified in the chimpanzee), a great modification of structure was demanded in order to serve the new functional demand resulting from the assumption of the upright posture. This demand for muscular reinforcement was satisfied and supplied by the tail muscles. Since a comparatively weak sphincter sufficed to serve the pronograde type, whose visceral weight was on the ventral wall, the caudal muscles were left free to motivate the tail. However, with the increased strain on the pelvic outlet brought about by the assumption of the upright posture, additional protection was needed and supplied by an anatomic shift of the caudal muscles. Thus, the base of the tail was pulled forward to become a pelvic shutter. The caudal muscles hypertrophied, became tough and fibrous, and interdig-

tated with the sphincter so as to form a web as the most efficient means for supporting the pelvic viscera. In other words, the dramatic assumption of an upright posture

rôle, what does it accomplish? Finally, why is its recognition indispensable for the consistent surgical relief of the clinical entities that arise from anal infection?



FIG. 4. Prolapsed hemorrhoids. The "dentate level" (Fig. 3c) will determine the upper extent of excision.

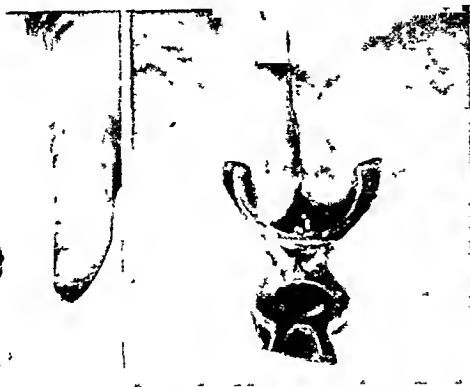


FIG. 5. Anal stenosis with ulcer. A portion of the "subcutaneous ledge" (Fig. 3E) must be excised in addition to the ulcer bearing area.



FIG. 6. Trans-sphincteric fistula. Inflammatory distortion renders "time-honored" landmarks useless.

by late anthropoids was accompanied by the marriage of two sets of muscles (tail and sphincter muscles) whose union was demanded by the need for increased pelvic support.<sup>6,7</sup> And thus was formed the anal web.

Here, an interesting corollary suggests corroboration for this hypothesis:

If the anorectal musculature was derived entirely from the primitive cloacal sphincter, it would be logical to assume that its nerve supply would be uniform. We would expect that the various morphological sphincter components would have common innervation. However, this is not the case. While the primitive sphincter derivatives are innervated by the inferior hemorrhoidal branch of the internal pudendal nerve, the profundus division of the sphincter is innervated by the fourth sacral nerve that originally was directed to the caudal muscle. This neurological mixture is a strong indication that the anorectal musculature is derived from the two sources under consideration, namely, tail and sphincter muscles.<sup>8</sup>

What is this structure that transforms the "ring series" into a web? From whence is it derived? In addition to its supportive

Responding categorically, the structure is the conjoined longitudinal muscle described by Levy in 1936.<sup>9</sup> It is "conjoined" because it receives musculofibrous components from the levator, the external longitudinal coat of the bowel and contiguous elements of mesothelial origin. It descends, partly through and partly from, the levator in the form of sheath-like skirts that pass centrifugally from the bowel wall through the sphincter muscle and thus divides the latter into anatomically distinct components. By virtue of its tough, musculofibrous texture and its course, it binds, connects, and reinforces the sphincter components so that the latter are interlaced and enmeshed according to the plan of a web. (Fig. 1.)

To all of this there is definite surgical significance. Not only does the anal web account for the patholytic mechanism by which the clinical entities are engendered, it also aids surgical orientation by revealing the structural scheme which determines the arrangement of the anorectal musculature. It explains why muscle spaces are formed and where they are located. It shows the paths by which infection may gain access to these spaces. It explains why the variety of

clinical entity depends upon the depth to which an infected anal gland penetrates the anal web. (Fig. 2.) But, in addition to this



FIG. 7. Infralelevator abscess. When communicating tract lies distal to puborectalis ledge (Fig. 3D) abscess can be cured in one-stage operation by excising necrotic anal lining with abscess.

correlation of structure to pathology, an even greater advantage is afforded to the surgeon.

The anal web affords indispensable landmarks which may guide the surgeon's procedure for draining the anal infections. These surgical landmarks are deviations in the morphologic contour of the anorectum which represent attachments of the anal web to the bowel wall, skin and surrounding bony structure. (Fig. 3.)

These true landmarks enable the surgeon to identify sphincter components, muscle spaces and space boundaries. The value of the precise orientation is proved by the practical application to the clinical entities. Hence, in removing a prolapsed mass of hemorrhoids (Fig. 4), the surgeon will know where to establish a "surgical dentate line": namely, at the normal dentate level.<sup>10</sup> When sphincter components must be divided for the creation of rest and drainage in the treatment of ulcer or fissure, spasm or stenosis (Fig. 5), he will first define the subcutaneous muscle by palpating the external and internal intermuscular grooves. When he is in doubt as to whether his plan for the adequate excision of a fistulous tract (Fig. 6) will jeopardize

sphincter integrity, he will palpate the puborectalis ledge, which is the last guardian of continence. When desiring to avoid the necessity for a secondary operation for the cure of infralevator abscess, his plan of treatment will be influenced by the precise determination of the muscular structures involved in such a plan. (Fig. 7.)

#### COMMENT AND SUMMARY

Since limited space prevents amplification in regard to the recognition and use of true landmarks in the treatment of the various manifestations of anal infection, we merely emphasize that the rectal surgeon cannot receive proper orientation from a few, time-honored, landmarks such as Hilton's "white line" and the line of anal crypts. The location of the former is usually misinterpreted because Hilton's definition is ambiguous; the location of the latter varies according to the degree of inflammation present. Both are subject to pathological distortion. Proper guidance is afforded only by palpating the structural contour of the anorectum and interpreting the deviations of contour in the light of anatomical concept. When this is done there will be truth in the well known metaphor: "The educated finger is a probe with an eye at its tip."

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# EFFECTS OF SULFONAMIDES USED IN CONJUNCTION WITH AZOCHLORAMID IN LOCALIZED INFECTIONS\*

## REPORT OF TWO CASES

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SEVERAL successful attempts have been made to increase the efficacy of sulfonamides as chemotherapeutic agents for the treatment of experimental infections of animals and natural infections of man. For example, it was shown that, both *in vitro* and *in vivo*, the antibacterial activity of sulfonamides is enhanced when the environmental temperature is increased above 37°C. (Wengatz, Boak, and Carpenter,<sup>1</sup> White,<sup>2,3</sup> Spink,<sup>4</sup> Weld and Mitchell,<sup>5</sup> Neter,<sup>6</sup> Belt and Folkenberg,<sup>7</sup> Bang,<sup>8</sup> and others). The administration of sulfonamides in conjunction with certain immune sera has been proved to be more effective than treatment with either agent alone (Branham and Rosenthal,<sup>9</sup> Branham,<sup>10</sup> Bullova, Osgood, Bukantz, and Brownlee,<sup>11</sup> Tager,<sup>12</sup> and others). Likewise, the combined use of sulfonamides and specific bacteriophage may yield favorable results in the treatment of staphylococcal infections according to Zaytzeff-Jern and Meleney.<sup>13,14</sup> In this connection it is interesting to note that *in vitro* sulfonamides may inhibit the development of phage-resistant staphylococci (Neter<sup>15</sup>).

The question presents itself as to whether or not increased antimicrobial activity can be obtained by the simultaneous use of two different chemotherapeutic substances. Osgood and his co-workers<sup>16</sup> studied the effect of neoarsphenamine plus sulfathiazole in marrow cultures and suggested the combined use of these drugs in the treatment of severe infections of man. *In vitro* experiments on the antipneumococcal activity

of optochin hydrochloride (ethylhydrocupreine hydrochloride) or beta-hydroxyethylapocupreine dihydrochloride used in conjunction with sulfapyridine failed to reveal any potentiating effects (Neter<sup>17</sup>). In contrast, sulfonamides and azochloramid exerted greater bacteriostatic activity *in vitro* toward hemolytic streptococcus, pneumococcus, and staphylococcus than did either compound alone (Neter<sup>18,19</sup>). This observation has since been corroborated by Schmelkes and Wyss.<sup>20</sup> Goldberger<sup>21</sup> recently presented his extensive observations on the potentiation of the sulfonamides in the local therapy of wounds and surgical infections by the use of oxidants. This author observed that sulfanilamide and sulfathiazole plus azochloramid or Lugol's solution exert greater bacteriostatic activity against *Staphylococcus aureus* in broth than do any of the compounds alone. Schmelkes and Wyss<sup>20</sup> made the interesting observation that azochloramid counteracts the antisulfonamide activity of para-amino-benzoic acid.

Goldberger<sup>21</sup> obtained favorable results in the treatment of localized infections by the use of sulfonamides, which were potentiated by the simultaneous administration of azochloramid, Lugol's iodine or zinc peroxide. In order to stimulate further investigations on the clinical applications of such synergistic effects, the following observations are briefly presented:

Sulfonamides in conjunction with azochloramid were used in the treatment of

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several cases of wound infections.\* In no instance were toxic effects noted resulting from this therapy. One case is of particular interest:

F. L., a white male, eighteen years of age, suffered from an infection of an old burn. Cultures revealed the presence of beta hemolytic streptococcus. The patient was treated with an ointment of sulfanilamide for eleven days. Following this treatment the hemolytic streptococcus disappeared from the wound; however, the infection persisted and the culture revealed the presence of *Staphylococcus aureus* hemolyticus, which caused coagulation of human plasma and, therefore, has to be considered as a pathogen. Sulfathiazole ointment was administered for nineteen days. All cultures remained positive for pathogenic staphylococcus. Subsequently, sulfathiazole (1 Gm. five times a day) was given by mouth for ten days. Again, staphylococci were recovered. Then, sulfadiazine powder was applied to the wound for ten days. Cultures still revealed the presence of pathogenic staphylococcus. Finally, a solution of azochloramid (0.2 per cent), sulfanilamide (2.25 per cent), sodium tetradecyl sulfate (0.1 per cent), and triacetin (97.45 per cent) was applied to the wound for eight consecutive days. Cultures taken during this period and the following eight days remained sterile. However, ten days after this treatment was discontinued, pathogenic staphylococcus was again recovered. These observations suggest that the combined administration of sulfonamides and azochloramid resulted in transitory disappearance of staphylococcus from a wound, a result which was not obtained by local or systemic administration of sulfonamides alone.

A second observation on the effects of sulfonamides used in conjunction with azochloramid follows:

J. G., a white female, two years of age, was admitted to this hospital because of pneumonia and empyema. The patient was given 15 gr. of sulfadiazine and then 5 gr. every four hours. The temperature dropped from 105°F. to 100°F. within two days. On the second day of hospitalization, sulfanilamide (5 gr. every four

hours) was substituted for sulfadiazine. This treatment was continued for eighteen days. Chest taps were done frequently. The amounts of fluid removed ranged from 1 cc. to 150 cc., with a total of approximately 750 cc. The number of viable streptococci was determined by means of poured blood agar plates; para-aminobenzoic acid was added to the culture medium to counteract any growth inhibitory effects from sulfanilamide. The concentration of free sulfanilamide in the exudate was also determined. Table 1 summarizes the results of

TABLE 1  
STREPTOCOCCAL EMPYEMA

Date	Treatment	Concentration of Sulfanilamide (mg. %) in Empyema Fluid	Approximate Number of Streptococci Per Cc. of Empyema Fluid
2-2-42	Sd	.....	.....
2-3-42	Sd	.....	.....
2-4-42	S	12.65	>1,000,000
2-5-42	S	9.38	5,000,000
2-6-42	S	9.2	5,000,000
2-7-42	S, AS	.....	.....
2-8-42	S	.....	2,400
2-9-42	S	.....	.....
2-10-42	S	13.2	400
2-11-42	S	12.9	.....
2-12-42	S	8.52	8
2-13-42	S	.....	.....
2-14-42	S, AS	3.6	1
2-15-42	S	.....	.....
2-16-42	S	6.0	0
2-17-42	S	.....	.....
2-18-42	S	.....	.....
2-19-42	S	.....	.....
2-20-42	S	9.3	0
2-23-42	—	1.0	0
2-25-42	—	trace	.....

S = Sulfanilamide (per os).

Sd = Sulfadiazine (per os).

AS = Azochloramid-sulfanilamide solution (intrapleurally).

..... = No determinations carried out.

these investigations. It may be seen from Table 1 that the exudate contained more than 1,000,000 viable streptococci per cc. in spite of the fact that free sulfanilamide in concentrations ranging from 9.2 to 12.7 mg. per cent was present. Twenty-four hours following the intrapleural injection of 10 cc. of azochloramid-sulfanilamide solution and simultaneous administration of sulfanilamide by mouth, the number of colonics had decreased to 2,400 per

\* The solutions of azochloramid and sulfanilamide were obtained from Wallace & Tiernan Products through the courtesy of Dr. F. C. Schmelkes.

cc. From then on, the number of colonies diminished steadily and, following a second intrapleural injection of the azochloramid-sulfanilamide solution, the exudate became completely sterile. Clinically, the patient was in very good condition. No operative measures except chest taps were carried out.

The remarkable decrease in the number of viable streptococci following the first intrapleural injection suggests that this treatment contributed materially to the sterilization of the exudate. It is likely that sterilization would have occurred also if the second intrapleural injection had been omitted. It may be mentioned that, except for a transitory rise in temperature, no toxic effects resulted from this treatment. It must be pointed out that a considerable degree of pleural thickening was present. Whether this is due to the infection itself or to the locally applied azochloramid-sulfanilamide solution cannot be stated with certainty.

Although these observations do not permit of any far-reaching conclusions, they suggest that in certain cases of localized infections, in which treatment with sulfonamides alone fails to result in cure, the combined administration of sulfonamide and chlorine compounds such as azochloramid may yield increased antimicrobial effects. This confirms similar observations of Goldberger.<sup>21</sup> It is hardly necessary to point out that a thorough investigation on the possible toxic effects resulting from this treatment should be carried out. In this connection it is well to keep in mind that the combined use of sulfonamides and other drugs may decrease the toxicity of the sulfonamide (Bodansky<sup>22</sup>) or enhance its ill effects (Harned and Cole<sup>23</sup>). The possible clinical applications of the synergistic action of sulfonamides and chlorine compounds deserve further attention.

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LOCAL causes of anorexia are mainly based upon a decreased hydrochloric acid secretion. This is particularly evident in carcinoma of the stomach, chronic gastritis, pernicious anemia, and other conditions with achlorhydria. It is not an absolute rule but is most evident in the first two. From "Symptoms in Diagnosis" by Jonathan Campbell Meakins (Little, Brown and Company).

# FEMORAL HERNIA\*

## A SIMPLE OPERATION WITH REPORT OF CASES

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THERE have been many contributions in the literature relative to femoral hernia. Most of these communications stress the rather high recurrence rate following operation and refer to some of the numerous and variable types of operations. It seems, however, that simple excision of the sac through the femoral approach without attempting to close the femoral canal, although strongly advocated by the late A. J. Ochsner,<sup>33</sup> has received little attention and has not been practiced to any great extent.

Therefore, we wish to report our late experiences with this type of operation, fully realizing the questionable value of so small a series of cases.

*Incidence.* Femoral hernia, as compared to inguinal hernia is not common. Most authors agree that the ratio of inguinal hernia to femoral hernia is from one to twenty-five or fifty; and that femoral hernia comprises from 3 to 5 per cent of all hernias. Coley<sup>8</sup> reports he has found that femoral hernia comprises 3.3 per cent of all hernias; Shelley<sup>41</sup> reports 5.35 per cent; Wilmoth<sup>50</sup> reports 3 per cent and other writers notably McClure<sup>28</sup> and Glenn<sup>20</sup> report a similar incidence. Herzfeld<sup>22</sup> reports only .04 per cent of femoral hernias occurring in a series of 1,000 hernia operations performed on children up to the age of twelve.

During the two-year period from July 1, 1939, to July 1, 1941, we have had a total of 6,128 admissions to the hospital and 515 were operated upon for repair of hernia. Of these 515 hernioplasties, 473 were for inguinal hernia and fifteen were for femoral hernia. This gives an operative ratio of

thirty-one inguinal to one femoral hernia; and of all types of hernia repaired, 2.91 per cent were femoral. Therefore, our operative ratio of femoral hernia is in accord with the incidence found by other authors.

*Side Involved.* Femoral hernia like inguinal hernia occurs more often on the right than on the left side.<sup>20, 28, 40, 47, 50</sup> According to Erdman,<sup>14</sup> femoral hernia is found twice as often on the right than on the left side. In our series of inguinal hernia we found 276 occurring on the right and 165 occurring on the left side; and of our fifteen femoral hernia nine occurred on the right side and six on the left.

*Anatomy.* A femoral hernia is a herniation passing downward through the femoral ring. Beneath this ring, the hernial sac dilates and becomes pear-shaped but rarely descends more than three inches before treatment becomes necessary. After the sac has passed through the femoral ring it becomes superficial.

The neck of the sac is bounded above by Poupart's ligament, posteriorly by the pectineus muscle, medially by the lacunar ligament (Gimbernat's) and laterally by the femoral vein.

*Variations in Presentation.* Variations in the method of presentation of the sac have been given various proper names, and although these variations are not common they occur often enough that the surgeon should be familiar with their position and nomenclature. Thus, Hesselbach's hernia consists of a hernial sac passing to the lateral side of the femoral artery, lying wholly in the lacuna musculorum. In a prevascular femoral hernia (Moschowitz<sup>32</sup>) the hernial sac descends in front of the

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femoral vessels and lies within their sheath. Cloquet's hernia consists of a hernial sac passing through the femoral canal to the lateral side of the femoral vein. It does not, however, like the ordinary femoral hernia, escape from the saphenous opening but spreads over the pectineal musculature and is covered by the pubic portion of the fascia lata. A hernial sac escaping through a defect in the lacunar ligament and entering the femoral canal, has been named a Laguer's hernia.

Although the content of a femoral hernia is ordinarily omentum or small intestine, cases have been reported wherein the sac contains an acutely inflamed appendix,<sup>21,23</sup> ovary or fallopian tube. In fact, Balch<sup>4</sup> states that almost all the abdominal viscera, with the exception of the spleen and liver, have been found in femoral hernias. When a Meckel's diverticulum is the sole occupant of the femoral sac, the hernia is known as Littre's hernia.<sup>49</sup> Since 1700, Stohl and McArthur<sup>44</sup> state that sixteen such hernias have been reported as becoming strangulated, and they add two cases of their own. Quiri<sup>37</sup> reports another case and so at least nineteen strangulated Meckel's diverticula have been found in femoral sacs. It is needless to state that not all Meckel's diverticula in femoral sacs become strangulated as Watson<sup>47</sup> has compiled thirty-four cases in which none were strangulated.

*Diagnosis.* The differential diagnosis of femoral hernia has been discussed by various authors<sup>4,10,15,24,27,40,51</sup> and these agree that the differential diagnosis of hernia is not always an easy matter. Very often the diagnosis can be established only by operation. In the differential diagnosis of femoral hernia one should consider inguinal hernia, femoral or inguinal lympho-adenopathy,<sup>27</sup> psoas abscess, varix of the saphenous vein, hydrocele of the cord, tumor of the tissue about the femoral region, or of the testicle, and a few relatively infrequent conditions such as cysts of the inguinal canal, undescended testicle,

cysts of the canal of Nuck and obturator hernia.

*Etiology.* The cause of femoral hernia remains today controversial. Many authors believe that the hernia is due to a congenital sac.<sup>25,47,48</sup> Others are of the opinion that the hernia is due to a weakness of the transversalis fascia<sup>32</sup> or an acquired sacular condition.<sup>31</sup> Recently, Salsbury<sup>39</sup> has postulated that intrauterine life, the position of the thighs flexed upon the abdomen which the fetus assumes, is an etiological factor. When the infant is born, there is a natural extension of the thighs with resulting traction upon the femoral vessels and other contents of the femoral canal with subsequent dimple formation of the peritoneum and allied structures. This is believed to create a weakness in this area which predisposes to the development of femoral hernia.

*Treatment.* It is generally agreed that the treatment of femoral hernia is surgical and that palliative treatment should never be used unless other systemic conditions render the patient obviously unfit for operation.<sup>26</sup> Surgery is recommended because femoral hernia usually causes more symptoms,<sup>50</sup> and becomes strangulated more easily than inguinal hernia.<sup>7</sup> Strangulation is eight to ten times more common in femoral hernia than in inguinal hernia and the presence of a truss may hasten the strangulation. Strangulated femoral hernia is also attended with a high mortality rate.<sup>13</sup> Mechanically, it is more difficult to keep a truss in place over a femoral hernia. DeGarmo,<sup>12</sup> at the New York Post-Graduate Medical School and Hospital, states that he has never seen a femoral hernia cured by the use of a truss.

During the past sixty years over one hundred different surgical procedures have been advocated for the cure of femoral hernia.<sup>5</sup> This clearly reveals the conflicting opinions and chaotic state from which one must choose a surgical procedure to effect a cure in femoral hernia. The well known and sound empiricism of medicine, where there are many remedies, it is a safe assumption

that none is absolutely curative is a doctrine that holds true in our present day treatment of femoral hernia. It is obviously beyond the scope of this paper to consider all the methods that have been advocated. However, in general there are four main types of repair, with two methods of operative approach, the femoral and the inguinal.

Probably the most widely accepted method of repair of femoral hernia is the method of Bassini through the femoral approach whereby three or four interrupted sutures are passed between Poupart's ligament and the pectineal fascia and several more sutures are placed to bring the falciform process of the fascia lata to the pectineal fascia. Ferguson,<sup>16</sup> DeGarmo,<sup>12</sup> and others advocate only uniting Poupart's ligament to the pectineal fascia and muscle by a few interrupted stitches, while Coley<sup>9</sup> advocated purse-string suturing of the femoral canal. It is interesting to note that recurrence rates as high as 35 per cent have been reported by various authors,<sup>4,8</sup> when either of these methods of repair is used. Watson<sup>47</sup> states that he believes the majority of recurrences when using either of these latter methods are due to a failure of the operator to close the femoral ring properly.

Lothoissen's method of repair, through the inguinal approach suturing the conjoined tendon to Cooper's ligament in an endeavor to close the superior orifice of the femoral canal, or some modification such as suggested by Keynes,<sup>26</sup> is a method commonly used. Moschowitz<sup>32</sup> recommends uniting the two structures, Poupart's ligament and Cooper's ligament, but this is not feasible in those cases presenting a rigid Poupart's ligament. The same may be said for the Roux modification, as the latter advocates inserting a metal staple through Poupart's ligament into the superior ramus of the pubic bone, in order to close the superior orifice of the femoral canal. The failure to lower the incidence of recurrences materially by these variously modified procedures would

seem to indicate that the distortion resulting from approximating these structures out of their normal alignment does not always result in a permanent union. Therefore, we believe that the method of repair to be used depends upon several factors and that each case of femoral hernia must be properly evaluated prior to instituting surgical therapy.

In 1879, Socin<sup>42</sup> suggested that simple removal of the hernial sac through the femoral incision without attempting to close the femoral canal, was curative for femoral hernia and he reported six cases treated and cured by this method. This type of repair has not been commonly accepted, but it is this type of repair that we desire to advance at the present time. We believe that if the technic is satisfactory, the method of treatment is curative, but it has been misused and hence not found satisfactory in the hands of certain men.

Since 1892, the late A. J. Ochsner<sup>33</sup> used this method and in 1906, he published thirty cases of femoral hernia cured by this procedure. Russell,<sup>38</sup> in Australia, emphatically supports the procedure; and similar statements are made by Burrows<sup>5</sup> and Percy.<sup>36</sup> As pointed out by Ochsner,<sup>33</sup> this procedure is curative because, if we may quote directly: "It is a well known fact that it is practically impossible to keep a circular opening in any part of the body from closing spontaneously unless it be lined with a mucous or serous membrane. The anatomic relations of the femoral canal are such as to form a definite circular opening." Ochsner<sup>34</sup> also stated: "When the circular femoral ring is closed with plain catgut the percentage of recurrences is small. When the orifice is sutured with chromic catgut the percentage of recurrences is greater. When silk is used, the percentage of recurrence is still more numerous. When the femoral ring is distorted by an attempted closure with silver wire, most of the operations will fail." Andrews<sup>1</sup> also is in accord with these principles and Herzfeld<sup>22</sup> advocates only simple

closure of the femoral hernial sac as curative for femoral hernia in children.

Our personal experience, to date, has been most satisfactory when repairing femoral hernias with only simple excision of the sac through the femoral approach. Twelve of the fifteen operations for femoral hernia that we have performed during the two-year period have been by this procedure. Check-up in a period of time, ranging from six months to two years since the time of operation, has failed to reveal any recurrences in ten cases. We have been unable to contact the other two cases as they have moved and have left no forwarding address. If one considers the statements of Masson,<sup>29,30</sup> Hook,<sup>23</sup> Foss and Hicken,<sup>17</sup> and others,<sup>20,45</sup> that 48 to 75 per cent of all hernial recurrences are evident in six months after the operation, it is possible that we may still encounter some recurrences among our present small series.

We believe, as stated by Burrows,<sup>5</sup> that this procedure should be used in simple femoral hernia, wherein the femoral ring has not been grossly distorted by past infection, trauma or congenital anomaly; but that it should not be used in patients presenting an abnormally large femoral defect or in those patients suffering from strangulated femoral hernia. Perhaps the recurrences among the patients operated upon by Keynes<sup>25</sup> utilizing this procedure and also those operated upon by Gask,<sup>19</sup> may be due to the fact that these men did not select their cases for this procedure.

The actual technic of the procedure is simple: A transverse incision is made over the femoral sac. The hernial sac is then dissected free from its surroundings. It is then opened and explored during which time the contents are returned to the abdomen. After it is determined that the sac is no longer adherent to the femoral ring, gentle traction is applied to the free end and it is ligated by transfixion with plain catgut. The sac is then excised. It will now be noticed that the ligated peritoneal stump retracts from the femoral canal. Any adipose tissue in or about the femoral canal

is then wiped away with a piece of plain gauze. No attempt is made to close the femoral canal. The skin and subcutaneous structures are then closed.

Since the operative procedure is so simple and can be done under local anesthesia, it should allow operative repair in those cases precluding more drastic surgical procedures. However, in our opinion, the inguinal approach and repair with fascial transplant by one of the methods advocated and variously modified by Gallie,<sup>18</sup> Auchincloss,<sup>2</sup> Austin,<sup>3</sup> Carscadden,<sup>6</sup> Payne<sup>35</sup> and others,<sup>11,43</sup> is the operation of choice for strangulated or complicated femoral hernia or the hernia with a grossly distorted femoral ring.

#### SUMMARY AND CONCLUSIONS

1. The subject of femoral hernia is discussed on the basis of a brief review of the literature and our own experience. Included are twelve cases of patients with femoral hernia upon whom the authors have operated during the two year period by simple excision of the femoral sac through the femoral approach without attempting to close the femoral canal. This method was strongly advocated by the late A. J. Ochsner but has received little attention and has not been practiced to any great extent. Ten of the twelve patients whom we have operated upon using this method have been followed from six months to two years and there have been no recurrences.

2. Femoral hernia, comprising about 3 per cent of all hernias, is more common on the right than on the left side, and the etiology is not yet definitely proved.

3. The recurrence rate for femoral hernia operated through the femoral approach including the Bassini and other methods for the closure of the femoral canal has been reported as high as 35 per cent.

4. The treatment of femoral hernia is surgical, and palliative treatment with a truss is contraindicated.

5. In simple femoral hernia excision of the hernial sac through the femoral approach without attempting to close the

femoral canal as advocated by the late A. J. Ochsner is the operation of choice, and in those patients so selected and so operated upon, there should be no recurrences.

6. In complicated or strangulated femoral hernia an inguinal approach should be made preferably using fascial transplant as the method of repair.

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# SURGICAL TREATMENT OF GUMMAS OF THE BRAIN\*

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ALTHOUGH gummas comprise only a small proportion of the number of space-occupying lesions of the brain, they still are of considerable importance, as signs of a cerebral neoplasm are not infrequently found in association with serological evidence of syphilis. In some cases brain tumor and latent asymptomatic syphilis actually co-exist. In other cases of brain tumor a false positive reaction is obtained in the cerebrospinal fluid in the absence of clinical evidence or a history of luetic infection. In still a third group a gumma of the brain may be responsible for the positive serology. Whenever serological evidence of syphilis co-exists with signs of increased intracranial pressure with or without a focal lesion of the brain the question of treatment naturally arises. In spite of the fact that the cumulated experiences of nearly all observers indicate that cerebral gummas are quite refractory to antiluetic drugs, a thorough trial is advised none the less even today. Nonne,<sup>1</sup> as long ago as 1913, urged that antiluetic treatment be abandoned and surgery employed if no response occurred within three weeks. Additional experiences<sup>2,3,4</sup> since then have confirmed this view.

Bagdasar,<sup>5</sup> reporting from Cushing's clinic, concluded: (1) That gummas were very rare. Of 1,550 tumors only eight were gummas. (2) The differential diagnosis between neoplasm and gumma is almost impossible. (3) Gummas practically always require surgical treatment. This should always be followed by the administration of antiluetic drugs.

The following cases were studied at the Mount Sinai Hospital and reiterate the principles described above:

## CASE REPORTS

CASE 1. (previously reported).<sup>6</sup> A thirty-six-year old waiter was first admitted on May 4, 1927. One hour before admission his right arm suddenly became stiff and numb and he was unable to move it. A few minutes later, a sensation of "pins and needles" began in the right hand and extended up the right arm and shoulder to the right side of the face. In a little while, he began to have clonic twitchings of the entire right upper extremity and the right side of the face. No other symptoms and no disturbance of speech accompanied the focal seizure.

On admission, he had a marked inguinal adenopathy.<sup>7</sup> The left pupil and the left palpebral fissure were greater than the right. The fundi, visual acuity and plotted visual fields were normal. There was slight clumsiness in the performance of skilled acts with the right hand and slight weakness of the entire right upper extremity. The abdominal reflexes on the right were diminished. The blood Wassermann was reported as "anticomplementary." Lumbar puncture revealed normal pressure. There were three lymphocytes per cubic mm. in the cerebrospinal fluid. The spinal fluid Wassermann and all spinal fluid studies were negative.

A tentative diagnosis of an expanding intracranial lesion in the left frontoparietal region was made. Before the diagnosis could be confirmed, the patient left the hospital against advice.

Three weeks later, on June 2, 1927, the patient was readmitted. He had been well after leaving the hospital until the day of his second admission when he again had the sudden onset of Jacksonian seizures involving the right upper extremity and right side of the face, this time associated with marked disturbance of speech.

The right pupil was smaller than the left. The pupillary reactions, the fundi, visual

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acuity and fields were normal. There was a right central facial weakness. There was a right hemiparesis which was most marked in the upper extremity. The deep reflexes on the right were increased. Perception of pain, temperature and light touch were impaired on the right side of the body. There was astereognosis and abaragnosis of the right hand. A mental status did not reveal any abnormalities. There was no evidence of aphasia.

The blood Wassermann this time was reported as "4 plus." Lumbar puncture again revealed normal pressure. The spinal fluid Wassermann and all other chemical and cytological studies were negative. An x-ray of the skull was reported as being within normal limits.

During the first week of his hospital stay, the patient continued to have infrequent, right-sided, Jacksonian seizures. On June 10, 1927, under local anesthesia, a left frontoparietal flap was turned down (Dr. Ira Cohen). Through the unopened dura a mass was palpated in the lower part of the left superior parietal lobule. The dura was incised and a tumor measuring  $2\frac{1}{2}$  by 2 by 2 cm. was exposed. This was adherent to the dura in a small area. The tumor was quite firm. It was well demarcated on the surface and easily separated from the adjacent brain tissue. About 2 cm. below the surface the tumor began to merge with the surrounding brain. It was excised to a depth of 2 cm.

On microscopic examination the tumor had an irregular zone of central necrosis surrounded by a zone of infiltration with lymphocytes, plasma, epithelioid and occasional multinucleated giant cells. This was surrounded by an area of newly formed capillaries, fibroblasts and lymphocytes. The vessels in the outer zone showed perivascular cuffs of small round cells. The diagnosis was gumma.

The patient had a relatively uneventful post-operative course. Antiluetic treatment with bismuth and neoarsphenamine was started at once. Two weeks after operation, he again began to have occasional right-sided, Jacksonian seizures which were easily controlled by anti-convulsant drugs. At the time of discharge, July 10, 1927, the patient was having no more seizures and the neurological examination, except for a slight weakness of the right hand, did not reveal any abnormalities. The patient was seen in the follow-up clinic about one year later and he was symptom-free.

**CASE II.** A fifty-six-year old housewife, was admitted to Mount Sinai Hospital on July 14, 1941, with complaints of headache of one year's duration, and memory loss and personality change of two months' duration.

One year ago she began to have mild intermittent headaches in the left frontal region. These persisted until five months before admission at which time they became more frequent and severe. They were not associated with any other symptom. Two months before she entered the hospital, it was noted by her relatives that her memory was becoming poor. At about this time she became disinterested and withdrew from all activity. She became slovenly and for the three weeks before admission, she refused to wash and had to be dressed. She was incontinent of urine on two occasions.

For many years she had a slight rhythmic tremor of the head. Two years ago, this increased somewhat and at this time she began to have a rhythmic tremor of both hands.

Examination on admission revealed her to be well nourished and well developed. There was a soft systolic murmur at the apex of the heart. Blood pressure was 140/80.

The pupils were round, regular, equal and reacted well to light and to accommodation. The fundi were within normal limits. There was a slight right facial weakness and slight spasticity of the right upper and lower extremities. A rhythmic tremor of the head and the hands was present. It was most marked in the right hand. All deep reflexes were hyperactive, more on the right. The abdominals were diminished. There was diminished plantar flexion on the right. The most striking findings were the mental changes. The patient was incontinent and untidy. She took no interest in her surroundings and lay in bed picking aimlessly at the bed clothes. There was marked poverty of affect with occasional silly and inappropriate smiling. There was wandering of attention and paucity and slowness of the stream of thought. She was unable to carry out the simplest commands. She was completely disoriented in all spheres. The mental picture was that of an organic reaction type.

X-ray of the skull showed the sella turcica to be somewhat small, with decalcification of the posterior clinoids and dorsum. Lumbar puncture revealed an initial pressure of 150 mm

of water. The fluid contained one lymphocyte per cubic mm. The Pandy was 4 plus.

Although the neurological findings were comparatively slight, it was believed that together with the profound mental changes they pointed to a tumor of the left frontal lobe. An electro-encephalogram showed diffuse abnormal activity with a focus of very slow, very high voltage delta waves in the left frontal region. Pneumo-encephalography revealed slight dilatation and displacement to the right of both the third and the right lateral ventricles. The left lateral ventricle was only partially outlined, and the anterior horn appeared cut off.

At this time the serological reports showed the Wassermann tests of both the blood and spinal fluid to be 4 plus. The colloidal gold curve of the spinal fluid was 33332221100; the spinal fluid total protein was 200 mg. per cent.

The patient was then started on antiluetic therapy consisting of potassium iodide, intramuscular bismuth and intravenous tryparsamide. An electro-encephalogram taken ten days after the therapy was begun revealed no change in the abnormal activity or in the focal accentuation in the left frontal region. By this time the patient, however, had begun to become drowsy and had developed bilateral papilledema with hemorrhages. Because of the progression of the patient's symptoms it was believed that operation could no longer be postponed.

Accordingly, on July 29, 1941, a left trans-frontal craniotomy was performed (S. W. G.). The dura in the left frontal region was found densely adherent to the bone. Through the unopened dura a hard nodular mass was palpated in the left frontal region extending from the left frontal pole posteriorly for a distance of 4 cm. When the dura was opened, a small amount of thick, yellowish exudate was found in the subarachnoid space. A transcortical incision was made at the posterior margin of the mass and it was then tilted out of its bed. The portion adherent to the dura was resected with the dura.

Microscopic examination of the tumor mass revealed a large central area of necrosis which was surrounded by an irregular layer of tissue showing early necrotic changes, a considerable amount of hyaline connective tissue and many extravasated red blood cells. External to this was a dense layer of connective tissue containing large numbers of lymphocytes and

plasma cells; here many of the vessels showed perivascular cuffs of small round cells and several giant cells. The outermost layer of the tumor consisted of a thick granulomatous proliferation of fibroblasts together with numerous lymphocytes, plasma cells and gitter cells. The diagnosis was "luetic granuloma."

The patient had an uncomplicated convalescence. Antiluetic therapy was continued without interruption after the operation. For the first few days postoperatively, there was increase in the pyramidal tract signs on the right and the patient became markedly euphoric and facetious. This subsided in a few days and thereafter she improved rapidly. Her papilledema subsided and the pyramidal tract signs on the right disappeared. Her emotional reactions became normal. She stopped being incontinent. Her memory defect cleared up remarkably and she became oriented in all spheres. At the time of discharge on the sixteenth postoperative day, except for the persistent tremor of the head and hands and for some slight blurring of the disc margins, her neurological examination was within normal limits. Mentally, she showed no abnormalities; her behavior was quite normal.

CASE III. A thirty-eight-year old housewife was first admitted to Mount Sinai Hospital on September 19, 1941, because of episodes of faintness, blurred vision and buzzing in the ears of two months' duration, and pain in the right eye of four days' duration. The patient had been married for eighteen years and had three children, who were living and well. She never had any abortions or miscarriages, and there was nothing in her past history to indicate a luetic infection. Five years ago she had a migrating arthritis, which subsided within two months on bed rest and drugs. Her present illness began two months before admission when she had the first of several episodes of faintness, blurring of vision and diminished hearing. These would last for several minutes and occur many times during the last two days of her menstrual period. In the interim, except for persistent buzzing in the left ear, she felt well. About one month before admission, her family noted that she was becoming somewhat careless in her dress and no longer took much interest in her household duties. This was in rather marked contrast to her previous neat habits. At this time she began to have a disturbance of recent memory, and in conversing

for any length of time she frequently forgot what she wanted to say. Four days prior to admission she began to have bilateral frontal headache and persistent sharp pain in the right eye. In the two days preceding her admission, she became nauseated, vomiting on several occasions and complained of blurring of vision.

General physical examination on admission revealed a well developed, well nourished white woman in no acute distress. The heart, lungs and abdomen were within normal limits. The blood pressure was 145/80. The pulse rate was very slow, ranging between 46 to 54; her temperature was normal.

The patient was drowsy and yawned frequently. She answered questions and carried out directions quite slowly. There was some tendency to perseveration of motor acts. Her manner was somewhat unrestrained, although there were no abnormal acts. There was definite flattening of the mood and occasional silly laughter. There was obvious difficulty in concentrating and some wandering of attention. Orientation and recent and remote memory were intact; there was some difficulty in retention and recall and in performing more complex calculations. Insight and judgment seemed impaired. There were no delusions or hallucinations. The gait was a trifle unsteady. There was slight terminal uncertainty on finger-to-nose test bilaterally. Motor power was intact. The deep reflexes on the left were slightly greater than on the right; the left abdominals were absent and those on the right were diminished; there was a left Babinski sign and a left Chaddock sign. There was slight blurring of the disc margins bilaterally and a left central facial weakness.

Lumbar puncture revealed an initial pressure of 150 mm. of water; the spinal fluid was clear and colorless and contained nine lymphocytes per cubic mm. and gave a 4 plus Pandy reaction. The blood Wassermann was 3 plus. Spinal fluid studies revealed a 1 plus globulin, a 4 plus Wassermann, total protein of 134 mg. per cent and colloidal gold curve of 33322211000.

X-ray of the skull showed a calcified pineal displaced slightly to the left and posteriorly. An electrocardiogram did not reveal any abnormality except for sinus bradycardia. An electro-encephalogram showed diffuse delta activity with slight accentuation over both frontal regions.

The tentative diagnosis on admission was an

expanding lesion in the right frontal region. When the positive blood and spinal serology became known, it was believed that the patient probably had a gumma in this region. Because she continued to be drowsy and had a slow pulse it was decided that air studies and surgical intervention were indicated even before a trial of antiluetic therapy.

Accordingly on the seventh hospital day, a left occipital ventriculography was performed. This revealed considerable dilatation of the ventricular system and especially the left lateral ventricle. The entire ventricular system was displaced to the left and there appeared to be a mass in the right temporoparietal region. The patient was returned to the operating room and under local anesthesia a right temporoparietal flap was turned down (S. W. G.). The dura was tense and adherent to a mass in the right supramarginal gyrus. When the dura was opened and separated from the tumor mass it was exposed as a grayish-yellow, well circumscribed lesion measuring about 3 by 2½ cm. The tumor was firm and rubbery in consistency and "warty" in appearance. It was removed *en masse*. The flap was closed in the usual fashion and the patient returned to the ward in good condition.

That same evening the patient became stuporous and despite supportive measures, the stupor deepened into coma. She remained comatose, developed respiratory paralysis and expired on the second postoperative day.

At the postmortem examination, she was found to have luetic aortitis, focal scarring of the inferior surface of the liver, a chronic ulcer of the duodenum, acute bronchitis and congestion with atelectasis of the right lower lobe of the lungs.

Grossly the brain was diffusely swollen. In the right temporoparietal region, close to the sylvian fissure and in the region of the supramarginal gyrus, a large operative defect measuring approximately 4 by 3 by 2 cm. was seen. At the base of the brain, the cerebellar tonsils retained the impression of the rim of the foramen magnum and apparently there had been a marked herniation of the cerebellar tonsils through the foramen magnum. There was little evidence of meningeal involvement except for clouding of the arachnoid over the cisterna magna.

On sectioning the brain, the two hemispheres were found to be asymmetrical. The ventricular

system was displaced to the left, and the right lateral ventricle was compressed. The operative defect in the right temporoparietal region had an irregular surface and apparently very little of the cortex had been removed at operation. There was considerable softening of the brain adjacent to the operative site.

Microscopic examination of the tumor removed at operation showed large central areas of necrosis surrounded by a zone of granulation tissue containing diffuse and compact perivascular infiltrations of lymphocytes and plasma cells. In several places, early stages in giant cell formation were noted. Peripheral to this zone was a layer composed of fibroblasts and capillaries containing many small round cells and plasma cells. The blood vessels showed swelling of the endothelial cells with cellular proliferation of the adventitia. There was considerable collagen tissue. The meninges appeared involved by a chronic inflammation. The tumor was diagnosed as a "luetic granuloma."

#### COMMENT

Gummas of the brain were frequently diagnosed in the days preceding the introduction of modern diagnostic and therapeutic methods in syphilology.

Bramwell<sup>7</sup> (1888) considered gumma to be the most common form of cerebral tumor of adults. Today, gummas are among the rarest of intracranial tumors. This striking reduction in the incidence of cerebral gummas parallels the decrease of gummas in other parts of the body since the introduction of salvarsan in 1909.

Our three cases represent an incidence of about 0.4 per cent of all the tumors of the brain operated upon at Mount Sinai Hospital since 1915. All occurred in adult life (thirty-six, fifty-six and thirty-eight years old).

Bagdasar's eight cases occurred in the age period of thirty to fifty-two. As far as could be learned there was no history of trauma to the head in any of our cases.

At operation the lesions in all three cases were strikingly similar in appearance. The tumor in each case was bound to the dura by inflammatory adhesions. They were all nodular, firm, rubbery, and fairly well

demarcated from the surrounding cerebral tissue. The histologic nature was strikingly similar. In each there was a large central area of necrosis surrounded by connective tissue and an outer zone of lymphocytes, plasma cells, giant cells and numerous blood vessels.

There was nothing characteristic in the symptomatology in any of our three cases, and gumma was not suspected until the results of the serological tests were reported. The first patient had a sudden onset of irritation of the motor cortex without signs of increased intracranial pressure; the second had headaches for several months followed by rapidly progressive mental deterioration; the third had attacks of faintness, blurred vision and diminished hearing followed by mild mental changes. The outstanding finding in this patient was a persistently slow pulse. The bradycardia was out of all proportion to the well being of the patient and was not properly evaluated. This patient succumbed after a simple and uncomplicated excision of the gumma, probably because of the marked herniation of the cerebellar tonsils through the foramen magnum as found at autopsy. The slow pulse was evidently a direct sign of pressure on the medulla.

In none of our patients was there clinical evidence of visceral or cardiovascular syphilis. The pupillary reactions were normal in all. The fundi were normal in Case I, papilledema developed during the period of observation in Case II and in Case III the disc margins were but slightly blurred. In Case II the posterior clinoids and dorsum sellae were somewhat decalcified. X-ray studies of the skull were otherwise normal in all three patients. Air studies were carried out and were of localizing value in Case II and III.

In each case the serological studies of the blood and spinal fluid first called attention to syphilis. In case I the cerebrospinal fluid was negative. The blood Wassermann was 4 plus and was thought to indicate latent syphilis in a case of brain tumor. When the lesion was exposed at operation, the luetic

nature of the disease was at once evident. In Cases II and III the blood and spinal fluid were both 4 plus. In each case a gumma was suspected preoperatively.

The diagnosis of gumma of the brain can be made with certainty only by inspection of the lesion at operation or postmortem examination. The clinical signs are those of brain tumor. If both the blood and cerebrospinal fluid are strongly positive, a gumma may be suspected. But the co-existence of neoplasm and syphilis can never be excluded clinically. Conversely, "a solitary gumma (of the brain) may exist without an abnormal lumbar spinal fluid" (Stokes).<sup>8</sup>

Positive spinal fluids have been reported from time to time in patients with proved nonluetic tumors of the brain. In 182 patients with brain tumors Merritt and Fremont-Smith<sup>9</sup> found a positive Wassermann reaction in the spinal fluids of four. None showed gross evidence of lues of the nervous system at autopsy.

In Case I lues was not thought to be responsible for the cerebral symptoms until a gumma was found at operation. Antiluetic medical treatment was not given until after the operation.

Case II deteriorated rapidly during antiluetic treatment. Her symptoms and signs cleared up very rapidly after a large gumma was extirpated from the left frontal lobe. Antiluetic treatment was given during the postoperative period and continued after the patient's discharge from the hospital.

In Case III no antiluetic medical treatment was given prior to operation. The luetic nature of her disease was not suspected until the results of the laboratory studies were reported. At that time she was drowsy and had a very slow pulse. The delay incident to a trial of antiluetic treat-

ment was deemed contrary to the patient's best interests. Unfortunately, death occurred about twenty-four hours after operation due to herniation of the cerebellar tonsils through the foramen magnum.

#### SUMMARY

Three cases\* of gumma of the brain in which surgical excision was carried out are reported.

The diagnosis of cerebral gumma can be made with certainty only by inspection of the lesion. In the main, the symptoms of gumma of the brain are no different from those of any other tumor. Gumma should be suspected when positive blood and cerebrospinal fluid serology is found in the presence of such symptoms.

Gummas of the brain should be removed surgically and be followed by persistent antisyphilitic treatment.

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# ARTERIAL AND VENOUS MESENTERIC OCCLUSION\*

## ANALYSIS OF FORTY-FOUR CASES

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REPEATED attempts have been made to outline a clinical symptom complex which might serve as a basis for the early diagnosis of mesenteric vascular occlusion. Indeed, it has been said that venous mesenteric occlusion can be segregated clinically from the arterial type.<sup>1</sup> Despite the efforts of investigators to clarify the picture, mesenteric vascular occlusion remains one of the most catastrophic of all abdominal emergencies, for therapeutic measures are usually to no avail even though the disease is recognized.

It is only by the analysis of large series of cases that the nature of the lesion can be clearly understood. Though much experimental work has been done on the subject, reports of large series are sparse. The most recent comprehensive analysis was that of Whittaker and Pemberton,<sup>2</sup> who, in 1938, reported sixty proved cases seen at the Mayo Clinic. Since then only sporadic reports of a few successfully treated cases have appeared in the literature.

Our study is based on a series of forty-four cases of portal and mesenteric occlusion seen at Michael Reese Hospital in the past ten years. Of these, forty were taken from necropsy records and four from case histories of patients who recovered. All but one were proved by operation or autopsy. The unproved case is presented to illustrate the possibility of spontaneous recovery.

### INCIDENCE

Perhaps one of the chief reasons for the failure to recognize the disease is its comparatively low incidence. For example, our

series represented 0.105 per cent of all surgical admissions (forty-four of 41,982) during the ten-year period studied. This figure is somewhat higher, however, than

TABLE I  
SUMMARY OF MESENTERIC VASCULAR OCCLUSION IN  
FORTY-FOUR CASES

Arterial Occlusion		Venous Occlusion	
Vessel			
Superior mesenteric alone.....	9	Superior mesenteric alone.....	8
Superior mesenteric and inferior mesenteric.....	2	Superior mesenteric and inferior mesenteric.....	1
		Superior mesenteric and portal.....	6
		Portal alone.....	15
		Smaller mesenteric veins alone.....	3
	11		33
Portion of Intestine Infarcted			
Jejunum.....	3	Jejunum.....	3
Jejunum and ileum.	6	Jejunum and ileum....	6
Ileum.....	0	Ileum.....	2
Entire small intestine and ascending colon.....	2	Entire small intestine and ascending colon	2
		Intestine not involved.	20
	11		33

that reported by Warren and Eberhard,<sup>3</sup> who found an incidence of only 0.041 per cent. Males were afflicted more often than females in our series. Arterial occlusions occurred in eight males and three females, while venous occlusions occurred in twenty-two males and eleven females. The fifth decade had the highest incidence, although three of our cases occurred in infants or very young children, aged ten days, eleven days and five years, respectively. The oldest patient was eighty-four years of age.

In no case of arterial occlusion which came to autopsy was the superior mesen-

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teric artery spared; it invariably contained a thrombus. Fifteen of thirty-three cases of venous occlusion involved the portal vein and fourteen the superior mesenteric vein either alone or together with the portal vein. In only three cases of venous occlusion were smaller mesenteric veins involved alone. We believe that this finding is most important in understanding the appalling mortality of the disease and the futility of surgical resection in many cases. The vessels occluded in each case are listed in Table 1. The inferior mesenteric artery was involved in two cases, while the inferior mesenteric vein contained a thrombus in one case.

The length of intestine involved by infarction or gangrene varied from 8 cm. to the length of the entire small intestine and half the large intestine in the proved cases. Of the cases of arterial occlusion the jejunum was affected in three instances, the jejunum and ileum in six and the entire small intestine and part of the colon in two. Of the cases of venous occlusion the jejunum and ileum were affected either alone or together in eleven instances and the entire small intestine and ascending colon in two. In twenty cases of portal or mesenteric venous thrombosis the intestine was not infarcted and appeared normal. All cases of infarction were of the hemorrhagic type. There were no instances of anemic infarction.

#### ETIOLOGY

Warren and Eberhard have presented the following outline of the etiology of mesenteric vascular occlusion:

1. Known infection: including thrombophlebitis, appendicitis, pelvic abscesses, peritonitis and general sepsis
2. Hematogenous causation: blood dyscrasias or changes known to predispose to thrombosis, such as splenic anemia and polycythemia vera
3. Traumatic: trauma of any sort to mesenteric vessels, tearing of mes-

entery and trauma from abdominal operations

4. Mechanical: largest group. Portal stasis, pressure from tumors, pressure from adhesions or congenital bands

Volvulus, strangulated hernias not included.

We have found a possible etiological factor in two cases which to our knowledge has not been previously reported. In both cases death from mesenteric arterial occlusion followed ablation of the lumbar sympathetic chain. Lumbar sympathectomy was performed in one patient while in the other the lumbar sympathetic ganglia were paralyzed by the injection of novocaine.\* We are not prepared to discuss the actual mechanism. It may be one of reflex vasodilation or the result of an underlying predisposition to thrombosis.

Fifteen patients (34 per cent) developed occlusion of the mesenteric vessels following abdominal surgery. Of these, two had arterial occlusion with infarction of the intestine; one followed resection of the Mikulicz type for a solitary cecal diverticulum and the other followed the accidental division of the superior mesenteric artery in an eleven-day old infant during operation for release of a congenital duodenal band. In three instances operation resulted in thrombosis of the superior mesenteric vein with infarction of the intestine. Of these, one followed cholecystectomy, one followed subtotal gastric resection, one followed gastrojejunostomy for carcinoma of the stomach, and one followed resection of the sigmoid for carcinoma. There were eight cases of portal or mesenteric occlusion without infarction which followed surgical procedures. This group included appendectomy for gangrenous appendix in three cases, cholecystectomy in two cases, drainage of gallbladder and appendectomy in

\* Since we have completed this study, Bauer has reported a case in which death was due to superior mesenteric thrombosis following injection of the lumbar sympathetic chain for thrombosis of the femoral vein. (BAUER, G. Venous thrombosis. *Arch. Surg.*, 43: 462, 1941.)

one case, gastric resection in one case, and gastroenterostomy with enteroenterostomy in one case. Twenty-nine cases (66 per cent) had no previous surgical treatment.

Table 11 lists the immediate etiological factors found in this series of cases. It should be noted that the predominating cause in younger patients was found to be heart disease or infection, whereas in older patients the degenerative or malignant changes appeared to be most important.

TABLE 11  
SUMMARY OF CAUSE OF MESENTERIC OCCLUSION

Cause	Arterial with Infarction	Venous with Infarction	Venous without Infarction	Total
Abdominal operation	4	3	8	15
Heart disease	4	3		7
Arteriosclerosis	3			3
Liver disease		1	1	2
Malignancy		2	5	7
Abdominal infections		1	2	3
Splenic anemia			2	2
Congenital anomalies		2	2	4
Unknown		1		1
Totals	11	13	20	44

Of especial interest are those cases of portal or mesenteric venous occlusion which did not result in infarction of the intestine. Death in these cases was due to such factors as generalized sepsis, generalized thrombosis, toxemia or liver insufficiency. One case was that of a ten-day old male infant whose mother developed puerperal sepsis. The infant had acute oömphalitis with thrombosis of the umbilical, portal and splenic veins and died of peritonitis and sepsis. Another case was that of a thirty-five-year old female who died three weeks after delivery with generalized thrombotic phenomena following acute and subacute endometritis with retention of placental tissue. The uterine veins were involved by thrombosis which had extended into both common iliac veins, the inferior vena cava and inferior mesenteric

vein. There were mural thrombi in both auricles and multiple emboli in branches of the pulmonary artery.

#### PATHOLOGICAL PHYSIOLOGY

Regardless of the cause of occlusion of mesenteric vessels the results of such an occlusion will depend upon several factors: (1) Whether the occlusion be arterial or venous; (2) the caliber of the vessel involved; (3) the suddenness of the occlusion; (4) the length of time an occlusion persists before operation or death; and (5) the length of intestine affected by the occlusion.

*Arterial Compared with Venous Occlusion.* Litten<sup>4</sup> postulated that the superior mesenteric artery, though not strictly an end artery, still behaves like one. Sudden occlusion of the main artery experimentally, results first in violent spastic contractions of the entire small intestine and part of the colon, from the ligament of Treitz to the middle of the transverse colon. This reaction is interpreted as an anoxic response to the sudden cessation of arterial blood flow. The gut is firm, white and acquires a rippled appearance as a result of the contraction of the circular and longitudinal muscular coats. The intramural vessels are also compressed and the capillary blood is drained off by the veins. As the intestinal musculature becomes fatigued (or toxic?) it loses its contractability and gradually relaxes. Some portions of the musculature fatigue more quickly than others, so that after three or four hours the bowel acquires a spotty appearance. Bluish areas appear between areas which remain blanched. After four to eight hours, the entire musculature relaxes and the bowel wall gradually becomes blood-soaked.

The mechanism of hemorrhagic infarction following arterial occlusion has been a controversial subject since the days of Virchow, Cohn and Cohnheim. These investigators considered the engorgement a result of regurgitant flow from the veins. However, when Welsh and Mall<sup>5</sup> some years later found that the same end result was obtained when both the artery and

vein were ligated, these workers concluded that the hemorrhagic infarction was due to a reflux of arterial blood which came by way of collateral channels. More recent experiments<sup>6</sup> have shown that both views were partly correct.

As the musculature of the intestine relaxes the negative pressure created in both the arteries and veins is sufficient to draw blood back into the wall of the intestine. The mechanism can be likened to a rubber-bulb syringe whose nozzle is submerged in a fluid. After the bulb is compressed, its relaxation will draw fluid into the bulb. Even if both the superior mesenteric artery and vein are ligated, there is enough blood left in the mesenteric system to be sucked back and result in hemorrhagic infarction.<sup>6</sup>

Sudden occlusion of the superior mesenteric vein experimentally, immediately causes a bluish discoloration of the entire small intestine. The intestine does not become spastic but is relaxed. The course of such an animal is practically identical to that of an animal which is bled to death. The blood pressure slowly drops until death occurs. The blood volume is ordinarily reduced 50 to 60 per cent<sup>7</sup> and death occurs within two to twenty-four hours. The findings at postmortem examination are identical in venous and arterial occlusion though the latter animals survive somewhat longer. The intestine at time of necropsy is neither distended nor contracted. It lies in the peritoneal cavity in a semirelaxed condition, is edematous, plum-colored and its lumen is filled with dark blood. The peritoneal cavity contains a variable amount of plasma-like, blood-stained fluid. The fat of the mesentery is studded with petechiae. When the occlusion has existed for more than twelve hours, the intestine is covered by a sticky fibrinous exudate.

Scott and Wangenstein<sup>8</sup> have found that in dogs the average length of life following venous ligation was five and one-half hours; following arterial ligation twenty hours, and following ligation of both the

superior mesenteric artery and vein, nineteen hours.

*Caliber of the Vessel Involved.* In the dog, occlusion of the vessels of the second mesenteric arcades causes no circulatory embarrassment of the intestine. The injection experiments of Cokkinis<sup>9</sup> performed on cadavers showed that this is also essentially true in the human. Eisberg<sup>10</sup> has shown that there is a considerable decrease in the margin of safety following ligations of the first arcade or vasa recta. Ligation of the main mesenteric arteries or the colic vessels, or an oblique ligation of the second arcade which includes the terminal arch and vasa recta, has no margin of safety.

*Suddenness of the Occlusion.* When a thrombus forms very slowly, collateral circulation has an opportunity to carry the blood supply. Warren and Eberhard<sup>3</sup> have pointed out that a very gradual occlusion of the main vessel may in some instances result in infarction; in other instances there may be temporary symptoms of pain and intestinal hemorrhage; it may even result in no symptoms at all if it forms slowly enough. Laufman<sup>6</sup> has produced slow occlusion experimentally by placing a loop of cellophane snugly about the superior mesenteric artery in dogs. After about four months the animals died from inanition and anemia. Examination of the bowel revealed a low grade enteritis with erosion of the villi and leukocytic infiltration of the remaining mucosa and submucosa. There was no infarction, but the subserosal vessels contained thrombi. The cellophane had gradually constricted and had produced sufficient fibroplastic reaction to choke off the vessel. The lesion in the bowel apparently was the result of chronic anoxia.

*Length of Time Occlusion Persists before Operation or Death.* The onset of gangrene depends upon several factors. For example, if depletion of the blood volume occurs rapidly (as in massive venous occlusion) death occurs before gangrene can supervene. When a shorter segment of intestine is involved, the blood loss plays a less important rôle and the deprived intestinal

wall becomes ready ground for bacterial invasion. Thus, gangrene is more apt to be found if a short segment is involved, and death occurs from perforation and peritonitis. It is, therefore, clear that the length of time an occlusion persists before operation or death is not the sole factor in the production of gangrene. On the other hand, if the patient lives sufficiently long after the onset of hemorrhagic infarction, no matter what the cause, gangrene of the intestine will eventually set in.

*Length of Intestine Affected by the Occlusion.* It is known from the work of Welsh and Mall that if more than 5 cm. of contracted small intestine in the dog (lower jejunum or upper ileum) be deprived of arterial blood supply, the segment will undergo infarction and gangrene. In shorter segments, the circulation is preserved by blood entering at each end through the intramural channels. Eisberg showed that the longitudinal inosculature of the intramural vessels is effective only for a distance of 5 cm. However, Donaldson<sup>11</sup> has recently pointed out that a somewhat longer segment of intestine can survive following venous occlusion alone than following arterial occlusion. He believes that this point can be of practical use following release of a strangulation when the surgeon is confronted with the question of whether or not to resect. Nevertheless, we are convinced that the presence of pulsating vasa recta in such a segment is not always a good criterion for viability. Every surgeon of experience knows of instances in which resection was not done because of the presence of pulsations in a strangulated segment, only to have the patient die postoperatively with gangrene of that segment.

#### DIAGNOSIS

Many writers have outlined what they considered to be symptoms more or less specific for mesenteric occlusion. Reich, in 1913,<sup>12</sup> presented a classification of symptoms based on a statistical analysis. Various additions and some modifications have

been offered since that time. However, Whittaker and Pemberton<sup>2</sup> and Ross<sup>13</sup> have expressed the opinion that the symptoms of mesenteric thrombosis, insofar as they may be grasped, are those of acute intestinal obstruction, strangulation, rupture of a viscus or peritonitis. Our study has borne out this point of view.

Pain was present in almost every case, though there was no uniformity in its nature. Almost every variety of abdominal pain was manifested and we were led to the conclusion that the character of the pain was of little significance in the early diagnosis of the lesion. One distinguishing feature of the pain, perhaps, was the fact that in most cases it was agonizing, constant and usually overshadowed the vomiting. In ordinary obstruction, on the other hand, vomiting is usually the prime symptom. The variable character of the pain in our series was responsible for erroneous diagnoses of ruptured appendix, cholelithiasis, intestinal obstruction, ureterolithiasis, ruptured peptic ulcer and peritonitis.

Vomiting occurred in most cases. In some instances it preceded or accompanied the pain, while in others it followed the onset of pain. Bloody or "coffee-ground" vomitus occurred in only five cases (11.3 per cent). Fecal vomiting occurred in one case and led to an erroneous diagnosis of gastrocolic fistula.

The occurrence of constipation or diarrhea was by no means constant. Eighteen patients (41 per cent) complained of constipation, while five (11.3 per cent) had diarrhea. Melena or occult blood in the stools occurred in each of twenty cases in which tests for blood were done on the stools. Thirteen (65 per cent) of these were cases of venous mesenteric occlusion.

Findings of shock were recorded in twenty (45.4 per cent) of all cases. Eight of the eleven cases of arterial occlusion in this group showed definite clinical signs of shock. Seven of nine cases of venous occlusion with infarction were in severe shock for variable periods before death, whereas only two of twenty cases of venous

occlusion without infarction displayed the shock syndrome. Shock was most pronounced in patients with arterial occlusion.

*Physical Examination.* The temperature in the early stages was subnormal or normal, except in those patients with an underlying septic process. Subnormal temperatures were usually associated with the initial shock of the occlusion, but later rose to from 101°F. to 106°F. The temperature rise was apparently the result of dehydration, peritonitis and toxemia. The pulse rate was variable, though it was generally irregular and weak and varied from 98 to 180 per minute. The blood pressure, as a rule, was low, although it did not reach shock levels until late in the course of the disease. Pallor and cold sweat varied in degree depending upon the amount of pain and shock.

A rather constant finding was the moderate degree of abdominal tenderness as compared with the severity of the pain. However, there was no constancy in this series regarding the localization of whatever tenderness existed. The tenderness to palpation shifted or was generalized. These findings often varied from day to day in the same patient. Palpation of an abdominal mass was recorded in twelve cases (27.2 per cent).

Distention occurred in only fourteen cases (32 per cent) of this series. Ten (23 per cent) were cases of venous occlusion, and four (9 per cent) were of the arterial variety. Rigidity was recorded in only three cases (6.9 per cent), all of which were patients with arterial occlusion.

*Laboratory Findings.* It is usually said that the leukocyte count in patients with mesenteric vascular occlusion is out of proportion to the apparent severity of the illness. The white cell count in most of our cases varied between 15,000 and 30,000 per c. mm. of blood. However, we wish to emphasize not only those cases in which the leukocyte count never rises over 9,000 or 10,000, but also those early cases in which the white count has not yet begun to rise. In our series the leukocyte counts had

an extremely wide variation—4,000 to 90,000. The neutrophils usually numbered over 80 per cent. According to Hill and Stoner<sup>14</sup> and Harris and Feldheym<sup>14a</sup> the leukopenia in some cases is explained as a "leukocytic exhaustion" due to the absorption of toxic products from the involved intestine.

Hemoconcentration was noted in the two cases of venous thrombosis in which this determination was made.

Flat roentgenograms were taken in six cases and were reported as negative in four. In two instances, the lattice pattern of small intestinal obstruction was noted and was of no direct value in making a diagnosis of mesenteric occlusion.

*Duration of Symptoms.* We met with the same difficulties encountered by others<sup>3</sup> in tabulating the time between the first appearance of acute symptoms and exploration or death. In many cases no such conclusion could be reached. Often the original mild symptoms were apparently due to some totally unrelated intra-abdominal disease. There was no apparent relationship between the duration of symptoms and the severity of the lesion. In some cases with extensive infarction, symptoms were of very short duration. As closely as they could be estimated, symptoms referable to mesenteric occlusion varied in duration from four hours to two weeks. In general, the symptoms were of longer duration in cases of venous occlusion. This was an interesting finding in view of the fact that in the experimental animal venous occlusion causes death faster than does arterial occlusion. This discrepancy can probably be explained by the assumption that the early symptoms in patients with venous occlusion were not the result of total occlusion of the superior mesenteric vein, but that this condition gradually appeared as the thrombus extended.

*Summary of Findings.* Though we found no definite set of signs or findings pathognomonic for the disease, we were confronted with the following features: (1) The most outstanding feature was that, in

general, the clinical picture was that of an "abdominal emergency" most resembling intestinal obstruction or strangulation, although it was not typical of these conditions. (2) Pain was out of proportion to physical findings and usually persisted after antispasmodics or morphine were administered. (3) Shock was more pronounced than in most other abdominal conditions. (4) Melena or bloody vomitus occurred too late, as a rule, to be of diagnostic aid; they were more common in patients with venous occlusion. (5) Unless some obvious etiological factor was elicited in the history it was almost impossible to distinguish clinically between arterial and venous occlusion.

In this series, thirty cases (68 per cent) were unsuspected until operation or autopsy. Careful study of the records led us to believe that this finding should be interpreted as not so much a lack of diagnostic acumen on the part of the clinicians, as the fact that the signs of occlusion were overshadowed by co-existing disease. Dunphy and Whitfield<sup>15</sup> brought attention to the fact that in 30 per cent of arterial cases in their series, the presence of coronary arterial disease or cerebral arteriosclerosis had rendered the patients moribund before the abdominal vascular accident occurred, while in 60 per cent of the venous group the terminal stages of cirrhosis of the liver or intra-abdominal sepsis were associated with an unrecognizable thrombosis of the mesenteric veins. In our series, nine patients (64.3 per cent) with arterial occlusions and thirteen patients (43.3 per cent) with venous occlusions could be classified as moribund at the time the occlusions took place. These figures, then, must be considered as the minimal mortality rate for these types of mesenteric vascular occlusion, for no therapy could have saved these patients.

#### MORTALITY

The mortality rate in this series coincides with that of other reported series. It was

90 per cent (forty of forty-four cases) if all cases with necropsy findings of thrombi in the portal and mesenteric vessels are included. Nine patients were operated upon for symptoms referable to mesenteric occlusion with an operative mortality of 67 per cent. Three patients recovered following resection of eight, twelve and thirty inches of infarcted intestine, respectively. Of the six patients who died following surgery, two died on the operating table and the others died from one to nineteen days following operation. Concomitant findings in these cases at necropsy were pneumonia in one case and associated heart disease and other thrombotic phenomena in five. Three of these patients had thrombosis of the portal vein.

Although one patient who recovered was not re-operated upon, and the evidence is equivocal, it is likely that this case was an example of spontaneous recovery of a small infarct. The patient was a female, age seventeen, who was operated upon for subacute appendicitis. Three days post-operatively the pulse became rapid, and a black stool (positive for blood) was passed. Though the clinical impression was that of a small intestinal infarct, conservative measures were followed (suction and par-enteral fluids). The patient's condition improved rapidly within two days, and she was discharged apparently well nine days after the appendectomy.

Some patients with mesenteric thrombosis succumb to co-existing disease before infarction of the intestine can occur. Other patients survive attacks of mesenteric occlusion. Several such cases have been reported in the literature.<sup>16</sup> Slow venous occlusion may not result in infarction of the intestine due to the establishment of collateral channels. In this series there were twenty cases of portal or mesenteric venous occlusion with no infarction of the intestine, in which death was either due to co-existing disease before infarction could occur or in which the thrombus developed so slowly that the circulation to the intestine was not embarrassed.

## TREATMENT

There is no doubt that resection is the only hope for patients with involvement of an appreciable length of intestine by infarction. However, there are two types of cases in which operation is of no value: (1) Cases in which all of the small intestine is deprived of blood supply, as in superior mesenteric occlusion; and (2) cases in which the patient's general condition is so desperate (due to co-existing heart disease, toxemia or liver impairment) that any operative procedure is out of the question.

On the other hand, we believe that many more patients with resectable lesions could be saved if proper preoperative and postoperative measures are carried out. Because of the severe shock due to blood and fluid loss, it is essential to correct the reduced blood volume and treat the shock before attempting surgery. The average sized blood transfusion of 500 cc. is of little or no value, as a rule. One must give massive transfusions to such patients in order to readjust the blood volume; transfusions of 2,000 or 3,000 cc. are indicated preoperatively. Because plasma volume is usually reduced to a greater degree than is the cell volume,<sup>7</sup> plasma transfusions are also in order.

When the shock is not very severe preoperatively, it may become so during or after an otherwise successful resection of a segment of infarcted intestine. This may be due to extension or propagation of a thrombus or the continued absorption of chemical and bacterial toxins which are the result of death of bowel tissue. To combat the postoperative propagation of thrombi, Murray<sup>17</sup> has advocated the administration of heparin during and after operation. Laufman<sup>18</sup> has shown experimentally that heparin should only be administered if resection has been carried out. If resection is not done, it is dangerous to administer an anticoagulant because of the added blood and fluid loss into the lumen and peritoneal cavity.

Exteriorization, in our opinion, should only be carried out if the patient's condition becomes very critical during operation, or if there is an associated peritonitis.

## SUMMARY AND CONCLUSIONS

Forty-four cases of mesenteric and portal occlusion are analyzed. Occlusion followed abdominal surgery in fifteen instances (34 per cent), while twenty-nine patients (66 per cent) developed the condition following various nonsurgical diseases. The predominating etiological factors in this group were heart disease or infection in younger patients, and degenerative or malignant changes in older patients. The fifth decade had the highest incidence. Two cases of mesenteric arterial occlusion followed ablation of the lumbar sympathetic ganglia. There were eleven cases of arterial occlusion with infarction of the intestine, thirteen cases of venous occlusion with infarction and twenty cases of venous occlusion without infarction. The pathological physiology, as correlated with animal experiments, is reviewed.

Though we did not find any definitely pathognomonic signs or symptoms for the condition, the most outstanding feature was the clinical picture of an "abdominal emergency" most resembling intestinal obstruction or strangulation. Pain and shock were out of proportion to other signs. Nine patients (64.3 per cent) with arterial occlusions and thirteen (43.3 per cent) with venous occlusions could be classified as moribund at the time the abdominal vascular accident occurred. These figures must be interpreted as the minimal mortality rate, inasmuch as no therapy could have saved these patients. Further, these figures help explain the appalling mortality rate ordinarily associated with the treatment of mesenteric vascular occlusion.

The mortality rate in this series was 90 per cent of all cases, while the operative mortality rate was 67 per cent of nine cases subjected to surgery. Replacement therapy with huge blood or plasma transfusions preoperatively and postoperatively, is em-

phasized. Heparin should only be administered postoperatively.

The authors are indebted to the members of the surgical staff of the Michael Reese Hospital for the use of their cases, and to Dr. Otto Saphir, head of the Department of Pathology, Michael Reese Hospital.

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# CONTINUOUS CAUDAL ANESTHESIA\*

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THE treatment of varicose veins has long been a problem in this hospital.

Our experience has indicated that phlebectomy using the Mayo stripper has been the method of choice in a particular group of our patients. This has been so because of the impossibility of getting our patients, who are for the most part merchant seamen, to return for the frequent follow-up examinations required when varicosities are treated by ligation and retrograde injection. Also, in that group of patients who have had recurrences of varicosities after ligation and retrograde injection, we find indications for phlebectomy.

The technical difficulties of phlebectomy are due largely to the necessity of working on all sides of the extremity at one sitting and at the same time maintaining the strictest asepsis. In the past this has been accomplished only by having an assistant hold the extremity in a position that is often awkward and strained.

The recent work of Lemmon<sup>1</sup> in demonstrating that his flexible spinal needle could be maintained *in situ* safely for long periods has led us to extend this method to continuous caudal peridural anesthesia for use in phlebectomy. Because of the selective affinity of the local anesthetic agents for sensory nerve roots, the patient suffers no pain but has enough muscular control and position sense in the lower extremities to co-operate with the operator in holding his legs in positions favorable for operative procedures.

The disadvantage of caudal anesthesia heretofore has been its short duration. Because we have been able to prolong this type of anesthesia satisfactorily by

means of serial injections through a special apparatus, with the needle inserted through the inferior sacral hiatus into the sacral canal, we offer this method of anesthesia for the purpose of promoting further observations on the safety and the utility of the procedure.

In 1901, Cathelin<sup>2</sup> described perisacral anesthesia in a series of articles. He conceived the idea of medicating the nerves in this position for various pelvic neuralgias. He demonstrated that extensive anesthesia could be produced by placing the preparation outside the dura, that the dura was impervious to the anesthetic solution, and that there was no danger of direct action on the cord structures. Working with dogs, he showed that fluids when injected into the sacral canal rise by capillary action in the peridural space to a height in direct proportion to the amount of the preparation used and the speed of the injection. He showed further that when sufficient cocaine solution was injected into the sacral canal of the dog, it resulted in complete anesthesia of the entire body.

In 1911, Lawen and Gaza<sup>3</sup> found, by the use of colored solutions in epidural sacral injections, that the solution often ascended as far as the lower portion of the thoracic cord; while Muroya,<sup>4</sup> in a similar injection, found that the ascent of the fluid was often higher, even reaching to the cervical regions and into the skull outside of the subdural space.

We have found that this type of anesthesia may be continued for several hours if administered as a continuous peridural caudal block with injections made serially through this special apparatus.

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## TECHNIC

The patient is placed in the prone position and the skin over the sacral hiatus is

The anesthesia begins in from ten to twenty minutes after the initial injection. Operation about the lower extremities may be started in from fifteen to twenty min-

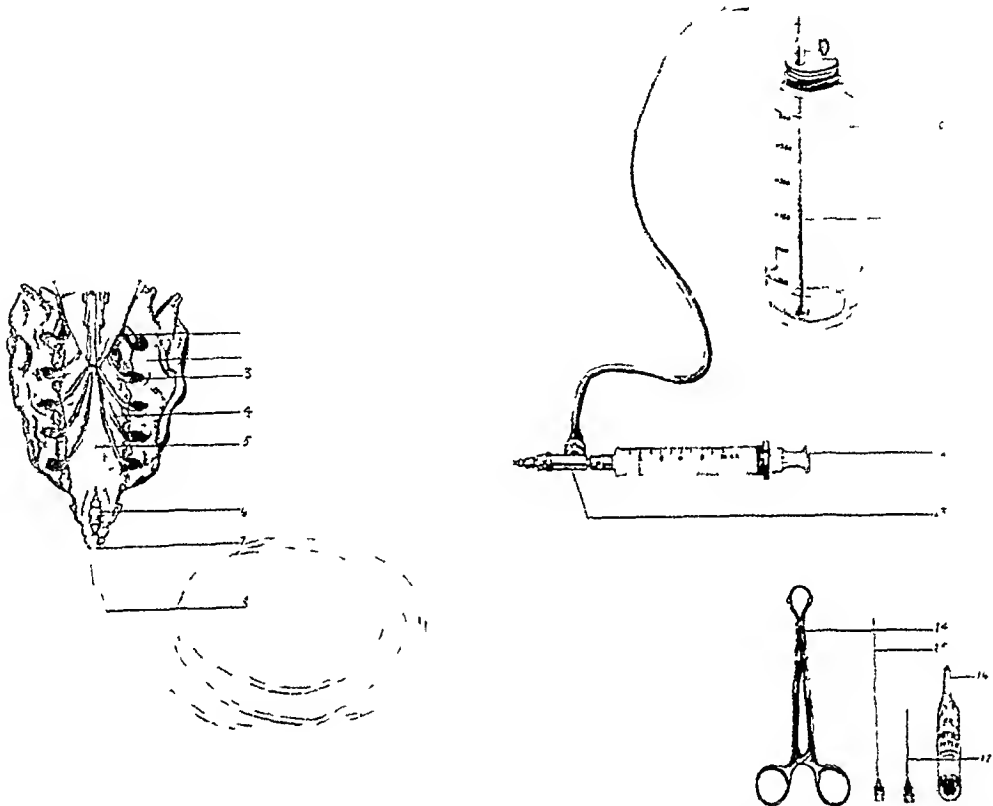


FIG. 1. Instrument for continuous caudal anesthesia. 1, Reflection of dura mater; 2, dorsum of sacrum; 3, second posterior sacral foramina; 4, sacral nerve trunk in caudal canal; 5, flexible stainless steel caudal needle ( $3\frac{1}{2}$  inch 19 gauge) B-D in caudal canal; 6, Luer-Lok connector; 7, distal coccygeal vertebra; 8, special noncollapsible rubber tubing with 1 mm. lumen; 9, 2 mm. rubber tubing; 10, 300 cc. graduated glass flask with rubber stopper containing  $1\frac{1}{2}$  per cent metycaine in physiological saline; 11, glass tubing with filter on end; 12, 10 cc. Luer-Lok syringe; 13, B-D 470 v valve for aspirating and injecting local anesthetic; 14, towel clip for breaking glass ampoule; 15, stilet for caudal needle; 16, 5 cc. ampoule with 20 per cent metycaine; 17, skin wheal needle (24 gauge).

prepared. A skin wheal is raised with metycaine or novocaine infiltration and the flexible spinal needle is introduced into the sacral canal. The rubber tubing with the Luer-lock attachment is connected securely to the needle and the other end of the tubing is brought over to a side anesthetic table as the patient turns to assume the position for operation. Through the distal end of the tubing, 60 to 80 cc. of 1 per cent metycaine are injected slowly into the peridural space.

utes. The anesthesia from the initial injection lasts from thirty minutes to one hour and a half. In the event the operation requires more time, other injections into the peridural space are given at a frequency and in a quantity depending on the reaction of the patient. In so far as possible the feelings of the patient should be anticipated by the anesthetist and subsequent injections made accordingly. We have found that these patients usually require a second injection of 20 to 30 cc. of the anesthetic

agent within forty minutes to one hour after the first injection. This may be repeated every thirty minutes for an indefinite period.

#### SYSTEMIC EFFECTS

The systemic effects are about the same as would be expected from an infiltration of the same amount of this anesthetic agent locally. In some cases the blood pressure rises about 15 mm. of mercury and in other cases it falls about the same amount. The pulse and respiration show minimum changes. The patient is able to move his lower extremities throughout the operation; some notice a diminishing muscular power as the agent infiltrates the anterior roots.

The patients are able to eat their meals on the day of operation. Water may be given to them in limited quantities by mouth during the course of a long procedure. In only an occasional case is a vasoconstrictor drug such as ephedrine necessary to fortify the blood pressure.

#### ADVANTAGES

We believe that this method has all of the advantages of spinal anesthesia without any of the disadvantages. Through this method we are able to get the patient to co-operate with the operator in shifting and holding positions necessary for the removal of long and tortuous varicosities that often circle the extremity. We have already used this method with our obstetrical service in the production of anesthesia throughout all stages of labor in sixty-five cases.<sup>5-6</sup> The longest surgical procedure for which this method was used was four hours and the shortest was two hours. The highest dosage of the drug metycaine in a 1 per cent solution was 265 cc., and this was used in the four-hour case. The anesthesia in our patients did not extend above the umbilicus. To date we have used this method for twenty surgical patients with satisfactory results in all of them. Most of these patients either had bilateral phlebectomies or bilateral hernioplasties. How-

ever, we have found the procedure worked satisfactorily in an appendectomy, a prolonged operation about the anus in which plastic repair was necessary and in a vaginal hysterectomy.

The following are given as illustrations:

#### CASE REPORTS

CASE 1. J. C., No. 98769. This man, a merchant seaman, presented himself for treatment of varicosities of long duration in both legs. He had been treated twice previously with operative procedures in the femoral regions, the latter of which was ten years ago. Examination revealed extensive, large, dilated, and tortuous veins in both thighs and legs. The deep venous circulation was found to be adequate and operation was advised. The anesthesia was induced by the injection of 65 cc. of 1 per cent metycaine solution into the sacral canal. Fifteen to 30 cc. were injected every twenty to forty minutes until the close of the operation four hours later. The blood pressure at the beginning of the anesthetic was 125/60 dropping to 110/60 at its close. The pulse remained at 80 throughout. During the first thirty minutes of the operation, which began ten minutes after the start of the anesthetic, the patient was able to localize the site of the operation and to determine if incision or suturing was being performed. He had no pain. After the first thirty minutes he could no longer localize the site of the procedure but was able to move his extremities at will. For incisions in the popliteal spaces he was able to rotate the extremities internally and hold them in position until that part of the procedure was completed.

CASE 11. No. 98719. This man, a merchant seaman, came for treatment of extensive varicosities of ten years' duration of both lower extremities. He had no previous treatment but had decided to seek relief because of marked increase in the size and extent of the dilated veins during the six months prior to admission. Examination revealed that the great saphenous veins and many of their tributaries on both lower extremities were enlarged and tortuous. The deep circulation was found to be adequate and operation was advised. The anesthesia was induced with 30 cc. of eucupin dihydrochloride in a 0.2 per cent solution and 40 cc. of 1 per cent metycaine solution. As insufficient anesthesia resulted in fifteen minutes, 15 cc. of 1 per cent metycaine were added. Within

another fifteen minutes the anesthesia was complete and was maintained with a total of 180 cc. of metycaine for two hours. The blood pressure and pulse remained at the preoperative level throughout.

CASE III. E. N., No. 98890. Phlebectomy was performed in this instance. The anesthesia for this patient was induced with 80 cc. of 1 per cent metycaine and was maintained for two hours with a total of 190 cc.

#### CONCLUSION

Continuous caudal anesthesia is a logical application of Lemmon's serial spinal anesthetic technic to continuous caudal block and may prove to be useful in a variety of procedures.

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PASSIVE motion under anesthesia is occasionally employed to break up adhesions. It is of the greatest value where the cause of restricted motion is not in, but about, the joint, and here it should be used only with caution, and by an operator with experience.

From "A Manual of the Treatment of Fractures" by John A. Caldwell (Charles C. Thomas).

# INCISIONAL HERNIAS FOLLOWING GALLBLADDER OPERATIONS

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THIS paper is an analytical study of 412 patients with gallbladder disease both acute and chronic, operated upon in the First Surgical Division at Bellevue Hospital during the past twenty years and on whom accurate follow-up records were available for at least a year but in the majority well over two years.

TABLE I  
ANALYSIS OF 412 GALLBLADDER CASES WITH REFERENCE  
TO INCIDENCE OF POSTOPERATIVE HERNIA

	Pa- tients	Oper- ations	Hernia	Per- cent- age
Right rectus splitting incision				
Acute cholecystostomy	24	...	6	25
Acute cholecystectomy	25	..	4	16
Chronic cholecystostomy	3	.	0	0
Chronic cholecystectomy	263	...	29	11
Transverse incision				
Acute cholecystostomy	1	...	0	0
Acute cholecystectomy	3	..	0	0
Chronic cholecystostomy	0	...	0	0
Chronic cholecystectomy	28	...	3	10.7
Oblique or subcostal incision				
Chronic cholecystectomy	16	...	0	0
Kammerer incision				
Acute cholecystectomy	1	.	1	100
Chronic cholecystectomy	18	..	4	22.2
Reverse Kammerer incision				
Chronic cholecystectomy	7	..	2	28.5
Right angle incision				
Acute cholecystectomy	1	..	0	0
Chronic cholecystectomy	3	..	2	66
	393	393	51	12.9
Double operations				
Acute cholecystostomy followed by acute or chronic cholecys- tectomy	19	38	8	21
	412	431	59	14.3

For the purpose of analysis the cases were divided into the acute and chronic, whether a simple cholecystostomy or cholecystectomy was done, whether an ostomy was followed by an ectomy, the types of incision used, the sex, age, general condition at the time of operation, postoperative complications, etc.

Table I is self explanatory and divides the cases according to the incision, the acuteness of the disease, the number of hernias and the relative percentage.

As can be noted there were 393 cases with fifty-one postoperative hernias, a percentage of 12.9 per cent. If to this group nineteen other patients are added who underwent two operations on our service, we have a hernia incidence of 14.3 per cent in 412 patients. If, however, we calculate the number of operations, we have 431 with a percentage of 13.6 per cent.

TABLE II  
ALL TYPES OF INCISIONS OF GALLBLADDER OPERATIONS

	Pa- tients	Her- nias	Per- cent- age
Acute cholecystostomy...	25	6	24
Acute cholecystectomy..	30	5	16.6
Chronic cholecystostomy	3	0	0
Chronic cholecystectomy	335	40	11.9

The highest incidence of hernias was in the acute ostomies done through a split rectus incision, and the Kammerer and reverse Kammerer incision in either the acute or chronic cases also seemed to leave a weak abdominal wall. In a small group of oblique and transverse incisions the percentage of postoperative hernias was low. The oblique or so-called subcostal incision used in sixteen patients resulted in no hernias and only three appeared in the transverse incision group. In the nineteen patients who had a cholecystostomy followed later by a cholecystectomy (both done on our division) the incidence of postoperative hernia was 21 per cent. Con-

sidering the fact that these patients were quite sick, I believe the percentage is not unusually high.

Grouping the cases according to Table II there were twenty-five acute cholecystostomies with six hernias all through a right split rectus incision.

TABLE III

Age	Sex	Complications	Hernia
77	M	None	Bulge at 6 mos., at 1 yr.
63	M	None	At 1 yr.
73	F	None	In a few mos.
65	F	Had asthma; drained 3 mos.	At 14 mos.
64	M	None	At 1 yr.
62	F	Had bronchicetasis; bronchopneumonia	At 2 mos.

There were thirty acute cholecystectomies with four hernias in the split rectus group and only one done through a Kammerer incision.

TABLE IV

Age	Sex	Complications	Hernia
62	F	Bad wound infection	Large at 1 yr.
60	F	Bad wound infection; bronchopneumonia; disruption of wound; secondary sutures	At 18 mos.
33	F	Two large drains; infection; partial separation of wound	1 mo. after discharge
62	F	Bad infection	At 1 yr.
47	F	Catheter drainage	At 8 mos.
(Kammerer)			

There were three chronic cholecystostomies none of which had any abdominal wall weakness. There were 335 chronic cholecystectomies with forty hernias. In the split rectus group there were twenty-nine, in the transverse there were four, Kammerer four, reverse Kammerer two and right angle incision two.

*A. Split Rectus Group.* There were twenty-nine of these, fourteen of which without any apparent cause developed hernia. The others are listed as follows:

TABLE V

Age	Sex	Complications	Hernia
Split rectus group:			
63	M	(Was nocardine); pneumonia	At 6 mos.
45	F	Separation of wound	Large at 18 mos.
36	M	Wound infection; pneumonia	At 3 mos.
41	F	Bronchitis	At 8 mos.
52	M	(Extremely stout)	At 4 mos.
53	M	Bronchopneumonia; suppurative pleurisy	At 1 yr.
62	M	Catheter drainage; bile drained 4 mos.	At 1 yr.
40	F	Bronchopneumonia	At 1 yr.
35	F	Bronchitis	At 8 mos.
57	M	Bad wound infection; diastasis	At 8 mos.
43	F	Drained 4 mos.	At 1 yr.
34	F	Bad wound infection	Large at 2 yrs.
43	F	Bad wound infection	At 6 mos.
47	M	Bad wound infection	At 1 yr.
44	M	Disruption of wound; secondary sutures	At 8 mos.
Transverse incision group:			
45	F	None	At 6 mos.
42	F	Bad infection; bronchopneumonia	Large at 2 yrs.
50	F	None	At 3 mos.
Kammerer incision:			
48	F	None	At 8 mos.
38	F	(Was a cardiac); pneumonia	At 6 mos.
59	F	(Very stout); had stab wound drainage	At 3 mos.
47	F	Catheter drainage; wound infection	At 8 mos.
Reverse Kammerer incision:			
54	F	Wound infection	At 8 mos.
55	M	None	At 1 yr.
Right angle incision:			
56	M	Wound infection	Large bulge at 2 yrs.
48	M	Wound infection	Bulge at 4 mos., hernia at 8 mos.

There were about twice as many women as men on the list of postoperative hernias but that is about the proportion as to sex found in the group as a whole. As to age, the youngest patient in our series was a young lady of eighteen who required an acute cholecystostomy followed by a chronic cholecystectomy one year later. The oldest was a man seventy-seven who had an acute cholecystostomy.

Studying the follow-up records carefully, it was found that in at least three cases, in which a definite weakness of the abdominal wall was noted in the first six months, all three apparently seemed to regain the muscular tone and even after three years there was no evidence of a hernia. Six

women were found to have become pregnant shortly after their operation; one was pregnant at the time she was in the hospital and none of them developed hernia.

There were eleven patients who had stab wound drainage with complete closure of the original incision. Only one, a very stout individual, developed a hernia. However, all eleven cases were chronic.

There were five cases of disruption three of which required secondary sutures. All were sick patients with other complications but the sickest of all, a diabetic patient, who had two operations an ostomy and then an ectomy two months later, had a solid abdominal wall eighteen months after the second operation. Another case, that of a simple ectomy was also solid after eighteen months. The other three had large hernial defects (60 per cent).

There were twenty-six patients who developed pulmonary complications ranging from a simple bronchitis to lobar pneumonia and in one case even suppurative pleurisy. Some of these cases also had other complications: cardiac, wound infection, etc. At any rate, twelve out of the twenty-six developed hernias (46 per cent).

An attempt was made to evaluate the importance of wound infection in the production of hernias. Although the case histories were carefully studied, I doubt if the percentage is absolutely accurate as it was difficult sometimes to determine if a patient was really infected or not. The description of the type, quantity of discharge and whether the patient stayed in bed over a certain period of time according to the acuteness of the disease were taken into consideration.

There were forty-one patients whose only complication was a wound infection. Eleven of these developed definite hernias (26 per cent).

#### COMMENT

In spite of the fact that a fairly large group of gallbladder cases (412) including

their follow-up records were carefully studied, no definite conclusion could be arrived at as to relative value of the incision used in relation to postoperative hernias, due to the fact that there was such a large number of operations done through a split rectus incision and so relatively few done through the other incisions.

It seems apparent, however, even with a small series that the subcostal or transverse incision leaves the abdominal wall fairly strong and less apt to bulge. In my opinion these two incisions should be the ones to use in most subacute or chronic cases.

That wound infection is a definite factor in the production of abdominal hernia is again brought out in our series. It apparently just doubles the incidence in comparison to the clean cases.

The same is true of pulmonary complications. These, too, demonstrated that patients with bronchitis, bronchopneumonia, lobar pneumonia, etc., were twice as apt to get hernia as the patients with no respiratory troubles.

Pregnancies, seven cases in our series, apparently had no deleterious effect on wound healing as none of the cases developed hernia.

It is interesting to note that in spite of a careful analysis no adequate reason could be found for the production of approximately half of the hernias. No analysis could be made as to the comparative value between silk and catgut as the operative histories were not complete enough in this respect.

The 412 patients were operated upon by the whole surgical staff of the First Surgical Division at Bellevue Hospital including the resident and house surgeons and give a very composite picture of the results in a large municipal hospital.

Gratitude is expressed to the former Directors and the present director, Dr. C. J. MacGuire, and the other members of the attending staff for the privilege of allowing me to use the records in making this analysis.

# FREE SKIN GRAFTS VERSUS FLAPS\*

## IN SURFACE DEFECTS OF FACE AND NECK

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THE purpose of this article is to review the factors which determine the selection of a procedure of choice for resurfacing skin defects on the face and neck.

This discussion is limited to the face and neck because of the special requirements which must be taken into account in these regions. Thus, while extensive scars on

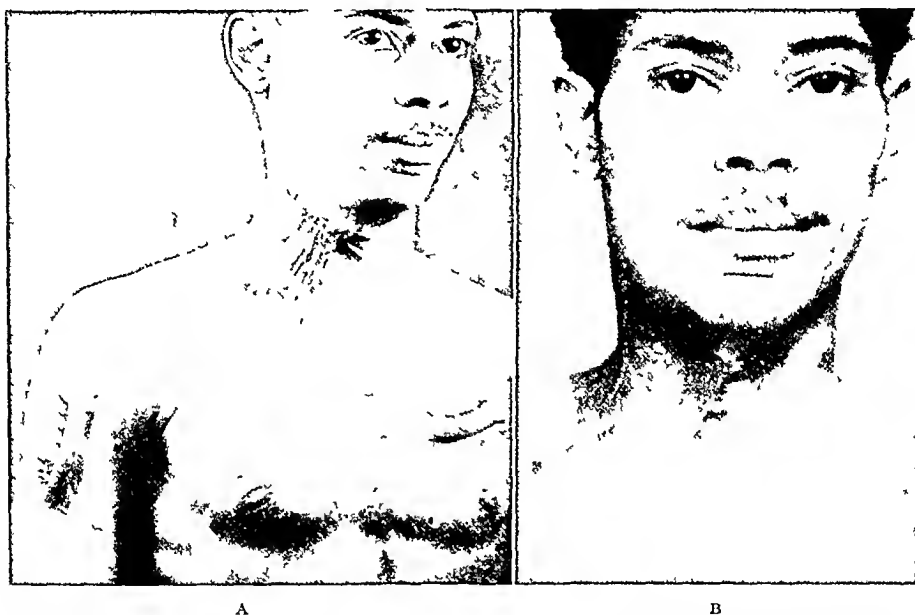


FIG. 1. A, scarring of neck following skin loss from a virulent streptococcal infection. The tube flaps on arm and chest outlined elsewhere for the repair of the neck defect were inadequate, too small and improperly placed. The use of a tube flap is unjustified in this case because of the number of operative stages which would be required. B, following excision of the scarred area the skin defect was covered by thick split graft, 0.024 of an inch in thickness. This type of graft generally provides a covering of acceptable color and a satisfactory neck contour. When some retraction of the graft takes place it is indicated to add a skin graft of greater thickness, a free full thickness graft preferably. A good take of these grafts necessitates a thorough immobilization under appropriate pressure.

It is agreed that early and permanent covering of a cutaneous defect is required for good health, function and comfort. The difficulty is to choose the most suitable method for each individual case. What are the reasons which govern the choice between free grafts and flaps for the restitution of a given part?

concealed body areas can often be left unattended, even limited skin losses on the face must be resurfaced, both for appearance sake and because of the danger of scar formation around the facial cavities with consequent distortion. The color and texture of the skin graft are also problems of great importance here.

\* Read at the Annual Meeting of the American Society of Plastic and Reconstructive Surgery, Boston, Massachusetts.

In planning the reconstruction, determination of the real tissue loss is the first step. Accuracy in selecting and outlining

stages required in the use of flaps, for example, demand a measure of economic security in the patient.

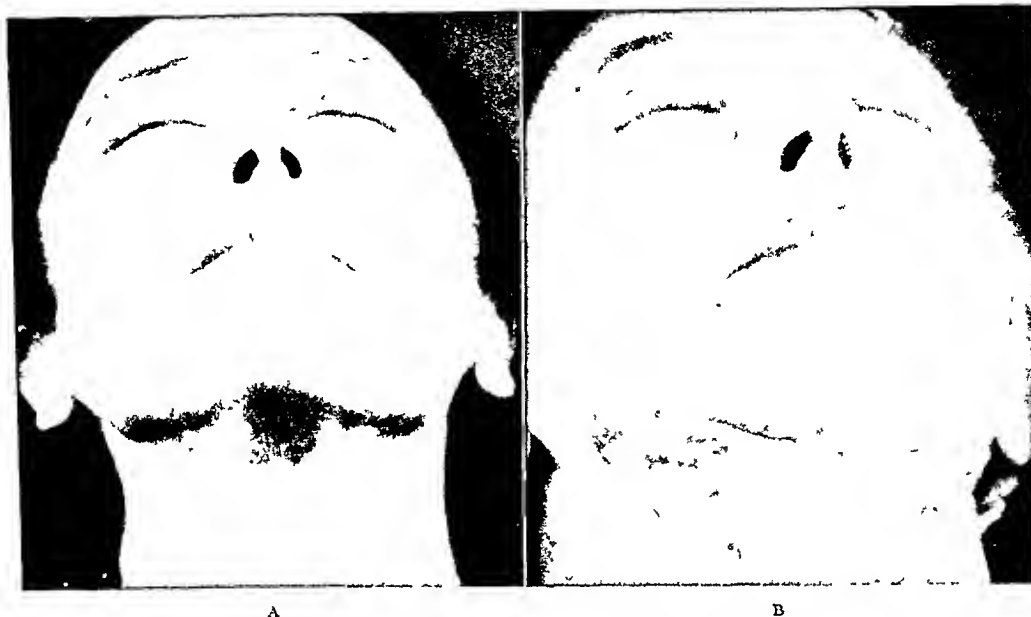


FIG. 2. A, radiodermatitis of neck and lower cheeks in woman of forty, with atrophy of skin and patchy pigmentation, following prolonged x-ray irradiation for removal of hair. The skin is leathery in spots with cracks tending to ulceration. The danger of malignant degeneration is sufficiently great to favor excision. B, appearance of the skin graft two months after surgery. Excision of the involved area was done along the mandibular border in the concealed area of the neck. A free skin graft, 0.024 of an inch in thickness, taken from the abdomen, covered the defect. Free skin grafts in this area are difficult to immobilize and require particular attention to adequate pressure and immobilization. Thorough immobilization requires inclusion of the head and chest into the dressing.

the required skin will depend on the precision with which the amount of loss is defined.

In addition to technical considerations, the patient's mental attitude, financial status, sex and age must guide the choice of procedure. We must treat the patient first and the deformity second.

*Mental Attitude.* Guarded opportunism is an important consideration in reparative surgery; and in this the patient's psychological outlook must play a part. Often the surgeon is called upon to decide whether certain risks should be taken in order to attain an ideal outcome, or whether an inferior procedure should be selected with less risk. The patient's attitude toward his deformity should influence this decision.

*Financial Status.* Financial considerations also play a part in the choice of procedure. The numerous, protracted surgical

*Sex.* The sex of the patient presents certain obvious considerations. For example, flaps from the neck and upper chest, acceptable in men, are usually contraindicated in women who expose these regions to a greater degree. On the other hand, forehead flaps are more feasible for women than for men, because of the greater ease of concealment by the hair. Of course these are not absolute rules.

*Age.* The problem of age is important. Protracted procedures require stamina and co-operation. Neither is usually found in the very old or the very young patient. As a rule, therefore, the shorter and simpler skin-grafting procedures are employed in early and late life.

This does not mean that necessary reconstruction should be postponed in children. Delay in removing scars during the period

of growth is often responsible for secondary deformities, due to maldevelopment of the bones of the facial skeleton and for serious psychic disturbances. *The profession as a*

growth. Witness the many cases of maldevelopment of the nose, chin and orbit due to injury and scar pressure in childhood.

In addition to the foregoing considera-

TABLE I  
FREE SKIN GRAFTS AND FLAPS

Type of Skin Graft or Flap	Donor Area	Type of Defect	Surgical Procedure	End Result
Thin (Thiersch) and thick split grafts Thickness: 0.008 to 0.026 inch	Abdomen; thigh and buttock; lateral chest; back	Granulating areas (thin grafts); mucous membrane loss in facial cavities; clean skin losses on face and neck (thick grafts)	Any sharp skin graft knife on stretched skin; Padgett's dermatome most indicated for cutting large sheets of skin	Color and texture improve with thickness; drawback; pigmentation; easy take
Full thickness grafts	Retro-auricular and upper eyelid grafts; (best for limited losses on face); arm (inner aspect); supraclavicular; abdomen; hair-bearing: (eyebrows and scalp)	Loss of eyelid and eyebrow; limited losses on cheek and nose; neck: in excessive contraction of thinner grafts	Careful dissection with knife, eliminating all fat; thorough immobilization under proper tension and pressure	Best cosmetically and functionally; more elaborate take
Small deep grafts (Davis). Include part of derm.	Abdomen; lateral chest; upper thigh	Clean granulating wounds (except on exposed parts)	By raising skin with straight needle and slicing off top of cone	Poor cosmetically; easy take
Derma—full skin without epithelium; for subcutaneous use only	Abdomen; lateral chest	Depressed areas of face—to restore contour	Prepared by shaving off epidermis with razor; used single or in few layers, with or without fat	Absorbs about 50 per cent—corresponding overcorrection necessary; easy take
Local flaps	Near skin loss: forehead, cheek, nose and neck	Loss on forehead, nose, cheeks, lips, chin	Outlined with proper length, width and thickness to assure adequate blood supply	Excellent in color and texture; easy take
Flaps from distance	Abdomen; lateral chest; upper chest; arm—inner aspect	Loss on nose, cheek and neck	Flaps transferred directly or through intermediate host-forearm; flap to be delayed if blood supply uncertain	Good in color and texture, although often too thick

whole is not yet sufficiently alive to the preventive value of reparative surgery in childhood. Too many physicians still believe that an injured part should not be skin grafted until it is fully developed. As a rule the contrary is true. Unless the constituent elements of the injured part are in proper alignment, the underlying structures will suffer during the period of

tions, the selection of a skin covering must be guided by the characteristics of the various free grafts and flaps now in use. There are three main groups (Table 1):

#### I. FREE SKIN GRAFTS

The main advantage of free skin grafts over flaps is the saving of time and expense

in their application. However, their usefulness on face and neck must be appraised in the light of the end result.

carded in favor of the thicker split graft (about 50 per cent of skin thickness) to prevent excessive contraction. I have had



FIG. 3. A, burn sears of face and neck in a girl age seven, with obliteration of the neck contour and recession of chin, due to sear contracture. B, reconstruction at first consisted in the preparing of a tube flap from lateral chest which was transferred to the left cheek and chin; subcutaneous fat taken with the flap corrected the depressed areas. C, the burn sears on the neck were not repaired until the age of eighteen, by a thick split graft (0.024 of an inch). The graft shown above is two months old and is abundantly pigmented. The contour of the neck, however, is satisfactory and is superior to the one which might have been obtained by a flap. The color of the graft is gradually improved and is approaching that of the surrounding area. Economic circumstances of this patient also favored a shorter procedure for the rebuilding of the neck.

**A. Thin Grafts.** Thin (Thiersch) grafts should not be used for permanent resurfacing of the face or neck because of their poor color and pronounced tendency to contract. They are pale, frequently pigmented, and, more often than not, wrinkle and contract when applied to areas without a solid base, such as cheeks and neck. Even as lining for the nasal cavities, sulcus of mouth, and orbit, the very thin graft should be dis-

to re-operate cases of nasal atresia in which obliteration of the cavity recurred as a result of the use of too thin a graft. Where appearance or contracture is immaterial, the thinner grafts can of course be used.

Thin grafts have a definite use as a temporary wound covering to be replaced later by a thicker graft or flap. This early, temporary resurfacing of wounds is proving its great value in war injuries, for it

saves time, promotes recovery and prevents infection.

*B. Thick Split Grafts.* The use of this

they are not able to give, namely, perfectly matching color and texture.

My personal experience with these grafts



FIG. 4. A, lupus of ear and cheek of about thirty years' duration, with malignant degeneration of auricle, following prolonged treatment by various physical and chemical agents. B, auricle amputated, lupus area of cheek widely excised and covered by a *thick split graft*. There has been no recurrence of either lupus or malignancy since surgery was performed nine years ago. The use of a full thickness graft would provide a better color, but its use was contraindicated because of the presence of an active local lesion and the possibility of recurrence. Wide excision, followed by skin grafting, is the procedure of choice, in the treatment of lupus cases unaffected by conservative therapeutic measures.

graft, first popularized by Blair,<sup>1</sup> has been greatly increased by Padgett's dermatome.<sup>2</sup> This instrument has made large quantities of skin available from areas from which it is not readily procurable by other means. As a result we can take larger and thicker intermediate grafts, which look better and contract less. (Figs. 1, 2 and 4.)

Undoubtedly, this instrument will contribute to the popularization of skin grafting among many who have heretofore neglected the early resurfacing of wounds because of inexperience with a skin graft knife. However, the fact that these grafts are easily procured and "take" better than full thickness grafts is no reason for using them indiscriminately about the face and neck. We should not look to them for what

has been disappointing in a number of cases. Although they look better than thin grafts and their "take" is more or less certain, as a rule their color is not good; quite frequently they are conspicuously pigmented. This pigmentation is a great cosmetic flaw because, once developed, it rarely disappears completely. (Fig. 3.)

Thick split grafts do best in areas with a resistant base, like the forehead and chin. On the forehead especially, they are useful for resurfacing the source of a flap.

Since Padgett's dermatome has made large intermediate grafts so easily available, they have proved valuable for the quick recovering of large skin defects of the neck. However, the color and texture of the skin are seldom completely satisfactory

nor do they often compare favorably with the end result of a good flap. Here is a case in which economy of time and risk must be

in the central portion of the neck over the larynx and on the cheeks in the vicinity of the mouth.



FIG. 5. X-ray burn of cheek with atrophy and telangiectasis following treatment for epilation in woman of twenty-four. A, six years after beginning of treatment an ulcer appeared on the right cheek which proved to be of malignant nature (squamous cell epithelioma). The entire area was widely excised and temporarily covered by a skin graft. B, a year later the resulting defect of the cheek was reconstructed by rotation of skin from the neck. To correct flatness of cheek a dermal graft was inserted subcutaneously but had to be removed because of excessive pressure. In this case the *quality* of the shifted skin was not good enough to sustain the pressure of an underlying dermal graft. C, a tubed pedicle flap from the arm fulfilled the indication in a satisfactory way. A safe transfer of the flap into the irradiated area required considerations relative to its blood supply: longer delaying and double pedicle. D, end result showing normal contour of reconstructed cheek, also corrective rhinoplasty.

weighed against the cosmetic end result. (Figs. 1 and 2.)

In addition to the often unsatisfactory color of these intermediate grafts, they are inclined to contract, sometimes markedly, requiring secondary grafting with full thickness skin. This is most likely to occur

**C. Full Thickness Grafts.** The full thickness graft is the preferred one of the free grafts for cutaneous covering on the face and for the lining of flaps. Cosmetically as well as functionally, it is superior to all others.

The subcutaneous tissue which these grafts develop in fair amount provides ful-

ness and mobility. They are more difficult to apply, sometimes blistering and showing areas of necrosis in difficult regions; but,

Free skin from the inner aspect of the arm is a second choice. For larger defects on the forehead, a free full thickness graft



FIG. 6. A, upper lip, hard palate and part of nose were removed for squamous cell epithelioma. B, hair bearing pedicle flap from cheek and upper neck, lined by a free full thickness graft, for reconstruction of lip. Distal end of flap transferred to the left corner of the defect. C, end result showing good contour of lip. Nasal prosthesis was provided following total amputation of nose because of recurrence of malignancy.

with the proper technic, they are employed successfully for the reconstruction of most areas of the face, notably the eyelids, eyebrows, nose and cheeks.

Particularly useful for these parts, because of excellent texture and color, are the full thickness grafts obtained from behind the ear, the upper lids and the supraclavicular region. These grafts, if available in sufficient amount from both sides, permit the grafting of fairly large surfaces. The donor area can usually be closed at once.

from the abdomen is preferable to an intermediate graft when color and texture count more heavily. The full thickness skin from the posterior aspect of the breast can readily be applied to the face in selected cases. The skin is thin, and usually pale, often matching that of the face in light complexion.

## II. SKIN SHIFTING AND ROTATION

The simplest procedure for the repair of a skin defect, wherever located, is undermin-

ing and advancement of the surrounding normal skin to close the defect without tension. To facilitate advancement of the

ranted by the superior end result. This method is contraindicated when the defect is in the vicinity of a facial cavity, and the

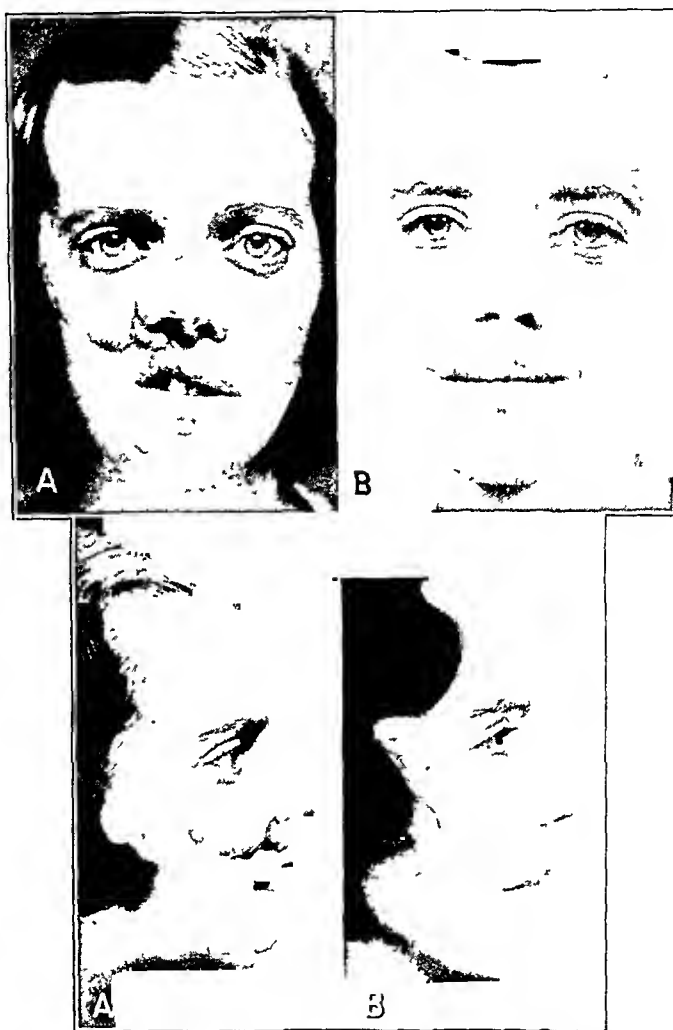


FIG. 7. A, post-traumatic partial loss of skin of upper lip. B, reconstruction by similar procedure as illustrated in Figure 6. Descending pedicle flap from lower cheek was used to cover skin loss of upper lip. No lining was required.

undermined skin, relaxation incisions are often used, permitting a wider range of rotation. Sometimes it requires several stages to cover a defect by this method, depending upon the elasticity of the skin.

The advantages inherent in the use of this procedure on the face are not sufficiently appreciated. Sometimes skin of different color and texture is transferred to the face when skin neighboring the defect could be used. The extra-operative stages required for this procedure are often war-

attempted closure would produce traction and distortion. (Fig. 5B.)

### III. LOCAL AND DISTANT FLAPS

Tubed and pedicle flaps have numerous absolute indications in the repair of surface defects of the face and neck. In such cases, skin grafts cannot be substituted for them. Indications for their use are as follows: (1) When there is a loss of skin and subcutaneous tissue (Fig. 5); (2) when lining as well as covering must be provided for defects

involving nose, cheek or lip (Figs. 6 and 7); (3) in areas with poor blood supply and exposed bone or cartilage.

employed, an attempt should be made to close the resulting defect by mobilization of the surrounding skin, thereby obviating



FIG 8 A, burn scar of neck in young child with strings extending from chin to chest causing retraction of chin and obliteration of neck contour. Thiersch grafting of the burned areas done elsewhere in a few stages. B, contour of neck restored by the use of a tube pedicle flap from lateral chest. Color and texture of the skin is good and cannot be surpassed by any other graft. Note that the excessive subcutaneous fat which often increases with age partly obliterates the normal contour. Removal of this fat is indicated during the adult age.

In order of their importance, the main donor areas for these flaps are forehead, cheek, arm, abdomen and thorax.<sup>3</sup>

Forehead flaps have a special usefulness in the reconstruction of nasal defects; they are superior to any distant skin in color and texture. To avoid conspicuous scarring, I prefer the temporal flap outlined horizontally under the hairline. When this is

the necessity for a free graft. The abundant blood supply of forehead flaps permits their transfer in a minimum time.

Ascending and descending flaps from the cheek may be used for reconstruction of the lip, especially in men, and for the reconstruction of the nostrils and nasal tip. (Figs. 6 and 7.) Small flaps from the nose, particularly from the lateral wall, can be

utilized advantageously for small losses of nostril.

Horizontal flaps from the neck, with incision placed in the natural fold, are suitable for use about chin and mouth. This same flap, extended toward the mastoid area, provides excellent skin for larger losses of the nose and para-orbital region. The color of the skin is second only to that of facial flaps.

Tubed flaps from the inner aspect of the arm still have frequent indications in the repair of nose and cheek, especially when skin from forehead and neck is not available. (Fig. 5.)

The acromiopectoral flap has not good color and should be used only when other flaps are unavailable. It is definitely inadvisable in women.

Although there has been a recent trend toward substitution of split grafts for flaps on the neck in order to reduce the time of repair, this is not always advisable. Especially in young women, the cosmetic factor must be given due weight. From this standpoint, the abdominal flap, or the flap from lateral chest transferred on wrist, provides a better skin covering. (Fig. 8.)

#### SUMMARY AND CONCLUSIONS

1. The procedure of choice for resurfacing skin defects on the face and neck must

be determined by the patient's age, sex, psychology and finances as well as by technical considerations.

2. While thin free grafts take easily and quickly, their color is not always good and they tend to contract. Full thickness grafts are the only ones which should be employed as a covering on the face.

3. Skin shifting and rotation is the simplest method for the repair of skin defects and provides perfectly matching skin. Its use is limited in the vicinity of facial cavities where the attempted closure would produce traction and distortion.

4. Tubed and pedicle flaps are indicated when there is a loss of skin and subcutaneous tissue, when lining and covering must be provided for defects involving nose, cheek or lip, and in areas with poor blood supply or exposed bone and cartilage. The main donor areas for those flaps are forehead, cheek, arm, abdomen and thorax.

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# THE PRESENT STATUS OF COOLING LIMBS IN PREPARATION FOR SURGICAL PROCEDURES

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FREDERICK ALLEN, his co-workers, and others, have sufficiently demonstrated the fact that limbs after cooling may be amputated without any other anesthetic. This procedure has now been used on a large series of cases, and it has been shown beyond doubt that amputation is less shocking, the mortality rate is far lower, and the results are as satisfactory as are obtained by any other method. In preparing a case for amputation, the following steps are taken: A tourniquet is applied to a limb, high above the site of contemplated amputation. The limb is then immersed in ice-water, or is surrounded with shaved ice, to just above the contemplated site of amputation. After one to three hours, the limb may be amputated at the site of election, without recourse to any anesthetic except that provided by the chilling. Patients undergoing amputation by this method have no pain, the operation is practically bloodless and shock is greatly diminished. It would seem that this method would have wide application in war surgery.

Allen has further suggested that with prompt cooling of limbs the time limit in which embolectomy can be performed can be lengthened far beyond four hours. Allen bases this statement on the fact that he has shown experimentally that cooling limbs subjected to local asphyxia by tourniquet or by ligating great vessels greatly prolongs the time a tourniquet can be left on a limb with resultant recovery when the constrictor is removed.

The above method of cooling limbs to be followed by amputation has been used principally in the treatment of poor risk patients, with diabetic or arteriosclerotic gangrene.

Some time ago I reported two cases as follows:

The first case was in an elderly man who was an extremely poor risk, because of a marked gangrene of his foot and leg, resulting in toxic absorption. This patient was suffering great pain in his foot and leg, was delirious, had a high protein nitrogen and was considered terminal. The affected leg was completely encased in shaved ice. Soon after icing all pain disappeared from his limb. Twenty-four hours later a tourniquet was placed tightly about the thigh, just below the site of proposed amputation. The tourniquet was included in the icing. Five days later his condition had so improved that amputation was performed just above the tourniquet site with no anesthetic, except that provided by the icing. This operation was practically bloodless, and appeared to be absolutely painless.

The second case was of a man who one hour previously had been run over by a railroad train, which had amputated his left leg, just above the knee, and his right leg, through the knee joint. The man was lying on the floor of the emergency room when I first saw him. His blood pressure was 30/0. He was given gum acacia through the veins of both arms. As soon as possible whole blood was given, because it was believed that it would be more beneficial than blood serum. The tourniquets, which the house surgeon had applied about the thighs were released, and all bleeding points were seized with hemostats, which were left in place.

The day of the accident was slushy, and because of the sudden application of the train's brakes the undercarriage of the cars had rained snow, mud, and sand over the limbs. This material was ground up and mixed with clothing, huge flaps of skin, muscle and bone. The ends of the stumps were ragged and extensively macerated.

Ten hours after injury the patient complained of pain in the left chest. He was irrational, and was tossing from side to side,

complaining of pain in his feet and legs. Twenty hours after injury a pronounced foul odor was emanating from the stumps. He was irrational. His blood pressure was 50/10. A consultant confirmed the diagnosis of pneumonia, and sulfapyridine was substituted for the sulfanilamide he had been getting. His temperature was 101.4°F. by axilla.

It was evident that nothing could be done at this time for the patient's lower extremities. The stumps were completely enclosed in shaved ice to two inches above the extent of tissue damage. No tourniquets were applied. Within one hour following the application of the ice all pain ceased in the lower limbs. Soon the foul odor from the stumps vanished. The patient became quite rational, and it was possible to take his temperature by mouth. The icing profoundly affected his temperature, because it fell to 97.2°F. by mouth. Heat blankets were applied over the patient's body and the temperature again rose to around 101°F. by mouth. Supportive treatment was given, including blood, and he was given three successive prophylactic doses of combined sera.

Fifty-eight hours later the patient's condition had markedly improved. Blood pressure was 110/60; fever was 101°F. by mouth. The pneumonia was not progressing. The patient was completely rational. At this time the patient was taken to the operating room and under ethylene anesthesia both lower extremities were elevated, high tourniquets were applied, and a simultaneous bilateral amputation was done. Recovery of this patient was uneventful.

#### COMMENT

At the time of operation there was no redness, induration, or ecchymosis of either thigh, at or below the site of amputation. During the operation the patient's blood pressure fell from 110 to 105. Five days after surgery the patient was sitting up in bed, reading the paper, and smoking his pipe. The stumps healed kindly, with no signs of induration or slough of skin or other tissue. There was slight drainage from each stump, but by the end of six weeks both stumps were practically healed.

The appearance of the amputated parts was interesting. They were cold and firm. There was no gross evidence of infection or

inflammation. The muscle was red and healthy looking. The fascia glistened. There were no blood clots. This was probably due to the washing achieved by the melting ice. The mud and sand were moist and looked as of the day of the accident. The particles of sand stood out in bold relief on the surface of the tissue, with no signs of sticking to the tissue, as is so often seen in wounds that are softened by disintegration. The subcutaneous fat was firm. A few pieces of skin had purposely not been included in the ice. These pieces were gangrenous and had a foul odor, while equally detached pieces of skin that were included in the ice were well preserved.

The icing in this case was used in order to prevent the advance of bacterial infection. This purpose was achieved. In addition, the icing stopped local pain, materially aided the patient in combating shock and stopped all odors emanating from the stump. Physiologically and bacteriologically, the above procedure would seem to be sound practice in combating pain, shock and advance of bacterial infection in cases of hopelessly traumatized extremities.

The question of how long normal skin can stand the application of ice without showing disintegration has been an interesting speculation. It has been shown by many workers that following the removal of ice, the reaction of the chilled parts is marked. The resistance of the tissue is greatly lowered and healing is retarded. It has been desirable, however, to find out how long skin could stand constant cold and maintain its vitality in a part to be amputated. Through the courtesy of Dr. Clair Carey, it is possible to report the following case:

A seventy-year old man, who had gangrene of the right foot and ankle, with severe pain, was admitted to the hospital in poor condition. He was irrational, noisy, and a morphine addict. His craving for morphine, according to him, was due to the severe pain he suffered in his leg. Previous to admission the gangrene had been dry, but two days before admission a rapid ascension of the gangrene had occurred,

and this was of the wet type. It was necessary to place him in restraints to keep him in bed.

This patient's right limb was encased in shaved ice to above the middle of the calf. This allowed the ice to extend approximately five inches above the extent of gangrene. Soon after icing, pain in the limb disappeared. The patient complained at times of a cold sensation at the juncture of the iced and the normal part of the limb. This patient was kept constantly in ice for twenty-eight days, with no damage to the normal skin enclosed in the ice. A mid thigh amputation was then done, and recovery was uneventful.

#### COMMENT

No tourniquet was applied at any time in this case, except at amputation. After the first few days of icing, the only medication that the patient received was 5 gr. of aspirin at bedtime. He became thoroughly rational, was able to enjoy his food, read papers and books, to shave himself, and to all appearances was comfortable and happy. His temperature, which had been high on admission, dropped to normal and remained so. The gangrene did not progress. There was no odor discernible. His friends and relatives visited him regularly, and they stated that as far as they could tell, he was perfectly oriented.

This case, then, is presented to show that cooling without tourniquet can, by lowering the metabolism of a part, prevent the absorption of toxin, the advance of bacterial infection, and can relieve pain. It

further shows that in parts to be amputated, it is possible, if the cooling is constantly maintained, to continue icing for long periods of time, without pain, and without damage to the parts.

The great problem in applying this method of treating the wounded in war time, is that of making a container that would be portable, practical and efficient in the theater of action. We believe that this problem is not insurmountable. Experimental work is now being done on two types of apparatus built for this specific purpose. If these units can be made practicable, this method of treating limbs should find wide application in severe wounds in both civil and military life. It would be of great value for combatting shock and hemorrhage and in holding infection in abeyance in hopelessly traumatized limbs or parts occurring in cases where surgical aid is not immediately forthcoming, either because of the patient or because of the circumstances under which the accident occurred.

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# SURGICAL TREATMENT OF CARCINOMA OF THE BREAST

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THE accepted treatment of carcinoma of the breast at the present writing is radical surgery accompanied by roentgen-ray therapy. Radical surgery alone or roentgen-ray therapy alone have proved insufficient. Simple mastectomy followed by roentgen-ray therapy is to be condemned. A simple mastectomy is permissible only to get rid of a putrid mass in advanced cases.

There exists some confusion as to when and how to administer roentgen-ray therapy. Adair now uses no preoperative radiation feeling afraid to wait the time required for this. He does use postoperative radiation. Mullen says, "I hesitate to wait in operable cases even a day." According to Bloodgood, "whenever there is the slightest sign of cancer of the breast, irradiation should be begun at once because when this is begun the danger of further delay stops. There is sufficient evidence to demonstrate that the moment irradiation of the breast and its metastatic area is begun, there is no further growth of cancerous cells in the tumor nodule or the metastatic area." Other clinicians give heavy doses over a period of several days believing they have better control of the lesion by this method. They claim that growth and spread cease although the histology of the tumor may not have been affected greatly. The writer believes in intensive irradiation both before and after operation.

The surgeon daring to operate should be prepared to do so thoroughly. An operation not done well and with meticulous care might just as well not be done at all. The absolute prerequisite for radical and complete surgery is a comprehensive knowledge of the anatomy so that the structures may be recognized quickly. With this knowledge the various steps of the operation can be planned and carried out in well ordered

sequence. The technic once developed can, with practice, be carried out rapidly so that the entire operation may be accomplished within forty-five minutes. The shortening of the duration of operation reduces considerably the risk to the patient and makes the procedure applicable to many who, through senility or weakness, are poor surgical risks.

The tissues to be removed may be enumerated briefly as follows: An area of skin, at least six inches in diameter and centered over the tumor should be removed, together with the breast and surrounding fat and underlying fascia. The fascia should be dissected over an area at least ten inches in diameter and should include the anterior sheath of the rectus abdominus and the external oblique muscles in their thoracic portion. The pectoral portion of the pectoralis major, the pectoralis minor, the costocoracoid membrane and all the areolar tissue along the brachial plexus, in the axilla and on the lateral chest wall. The dissection is commenced above and carried downward so that all the tissues are removed in continuity to avoid breaking across lymphatic channels.

The writer believes that the biopsy should be done at the time of operation after removing the mass as a whole and not cutting into it because of the danger of spreading carcinomatous cells. While awaiting the report on the frozen section examination the space from which the mass was removed should be packed with iodine impregnated (saturated) gauze and sewn up after which the procedure of the main operation is carried out.

## OPERATIVE TECHNIC

*Incision.* The usual incision is the racquet type, its character being varied to meet the needs of the case, following the

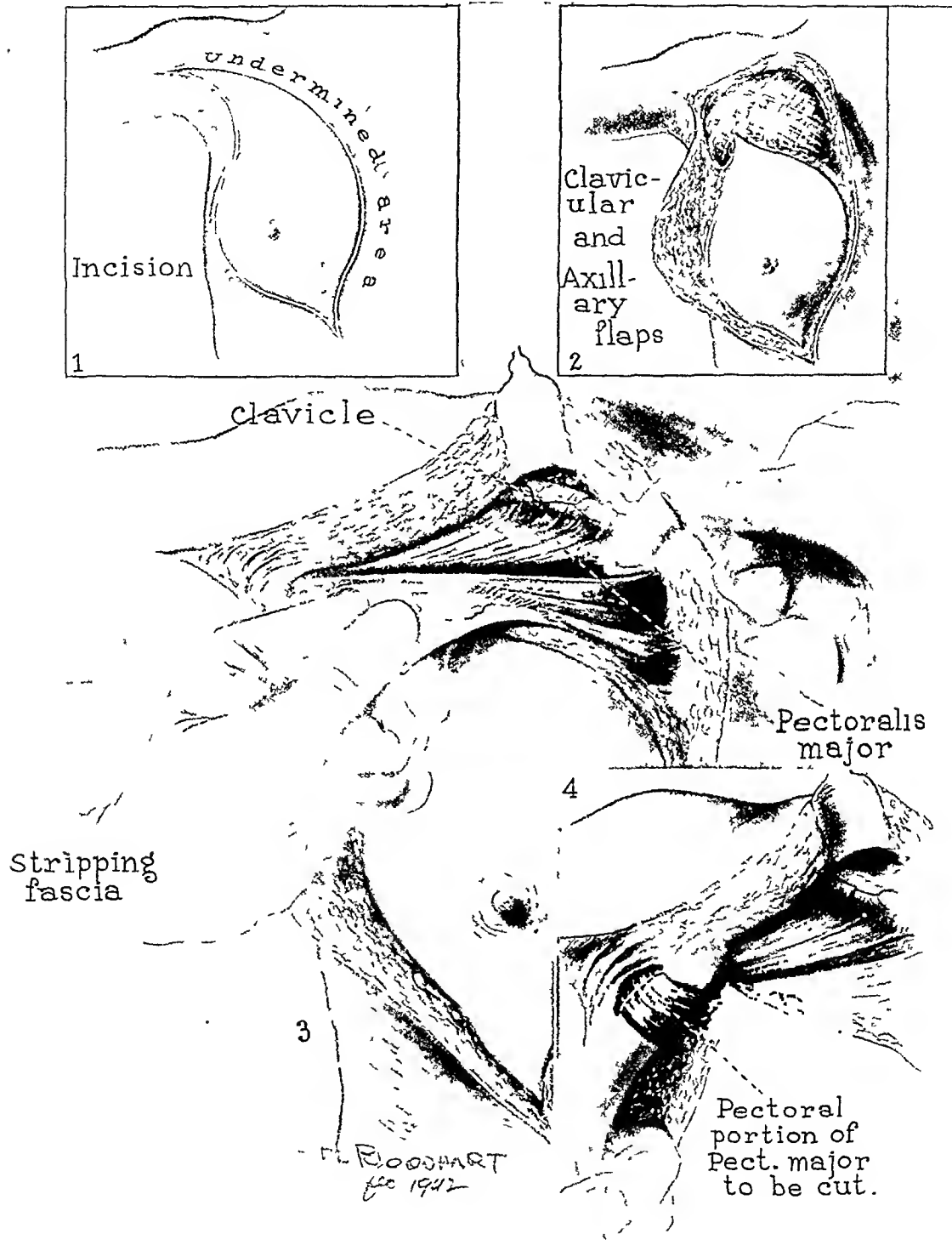


FIG. 1. The usual raquet incision and also the area of fascia to be removed.

FIG. 2. The extent of flap dissection at this stage.

FIG. 3. The fascia has been stripped downward from the clavicle and is shown held by the hand. The pectoralis major is being split into its two portions.

FIG. 4. The insertion of the pectoral portion of the pectoralis major is seen being isolated and the dotted line shows where it is cut across.

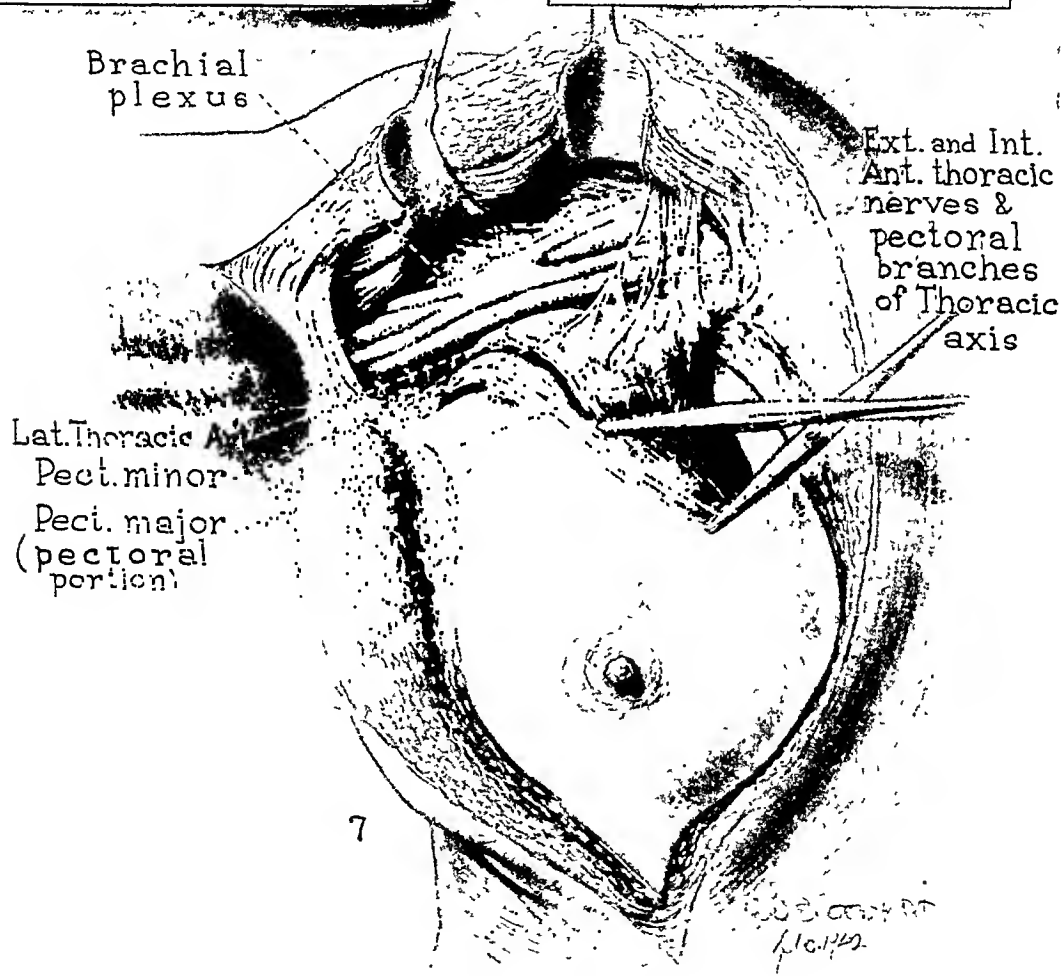
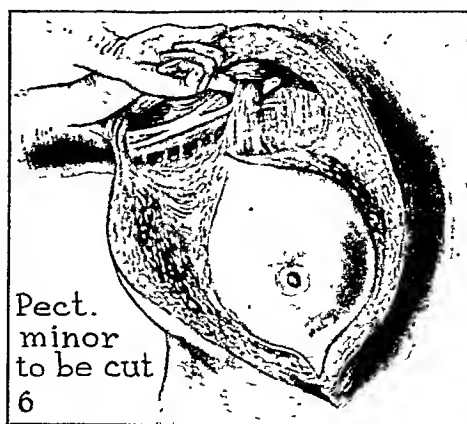
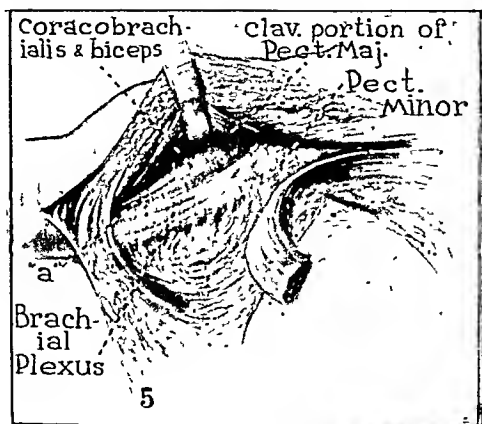


FIG. 5. Retraction upward of the clavicular portion of the pectoralis major brings the biceps and coracobrachialis into view. An incision in the fascia over these (dotted line) is made and the fascia is dissected downward exposing the brachial plexus which runs along their lower border.

FIG. 6. The arcolar tissue is cleared on the anterior surface of the brachial plexus upward until the pectoralis minor is reached. A finger is shown hooking under this and the muscle is then severed at its insertion.

FIG. 7. Medial to the pectoralis muscle, branches of the thoracic axis vessels and the external and internal anterior thoracic nerves may be seen crossing anterior to the axillary vein. These may be sacrificed as they run to the pectoral muscles.

rule of centering the skin area to be removed over the tumor. (Fig. 1.) Thought must be given to the desirability of closure

with and sloughing may occur. The axillary skin flap is now dissected downward a considerable distance to make dissection of

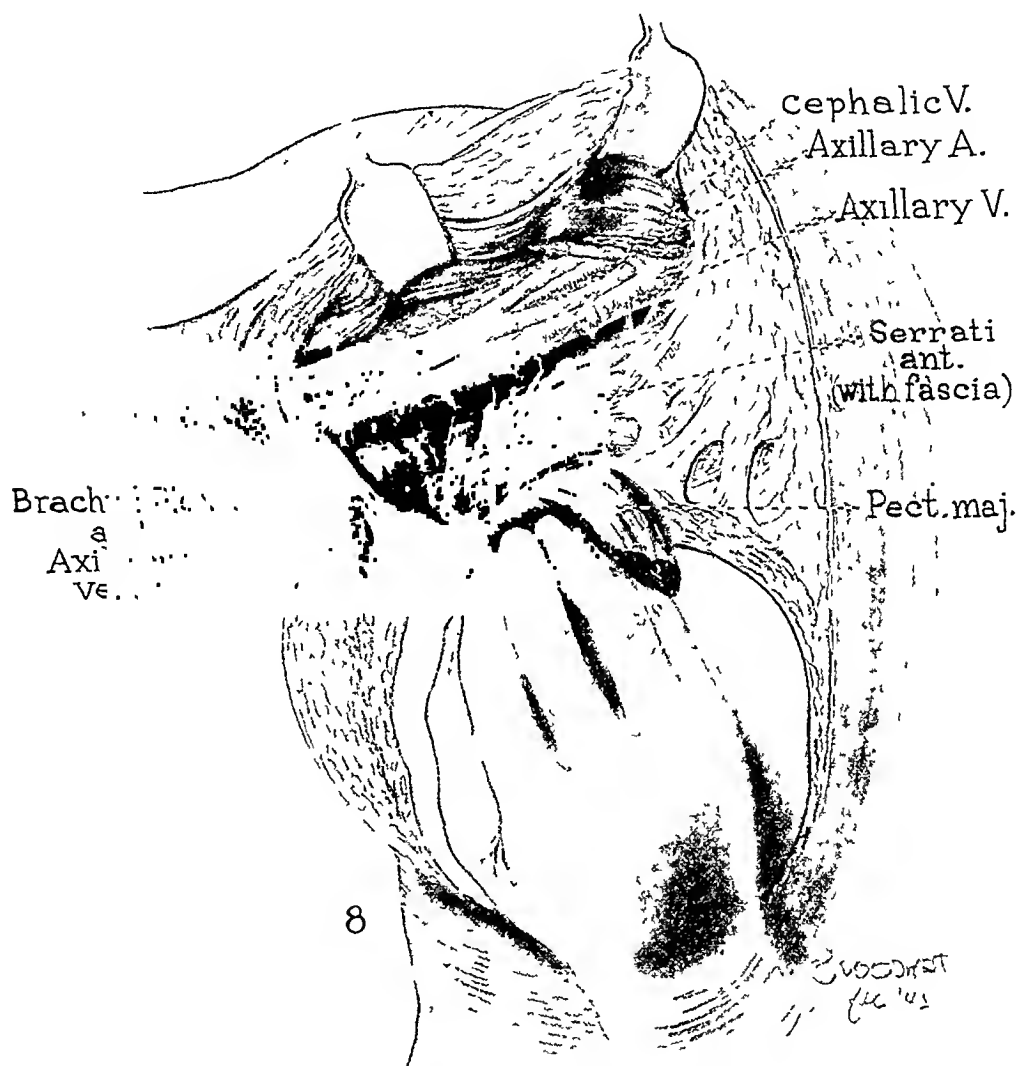


FIG. 8. The completed dissection of the lower border of the axillary vein, the tributaries of which have been ligated

of the wound, but it is more important to remove an adequate amount of skin. Closure usually can be accomplished by extensively undermining the flaps. One should avoid leaving a scar in the axilla, contracture of which may interfere with function.

The incision having been made, the clavicular flap is completed, leaving some fat adherent to the skin. If this is not done, the nutrition of the skin may be interfered

the axilla easier but it is not advisable to complete the flap all the way back at this time. (Fig. 2.)

Commencing at the clavicle, the fascia over the pectoralis major muscle is incised and dissected downward at least until the pectoral portion has been reached. (Fig. 3.)

The pectoralis major is split between its clavicular and thoracic portions and then a finger is hooked under the pectoral section and it is severed at its insertion. It is not

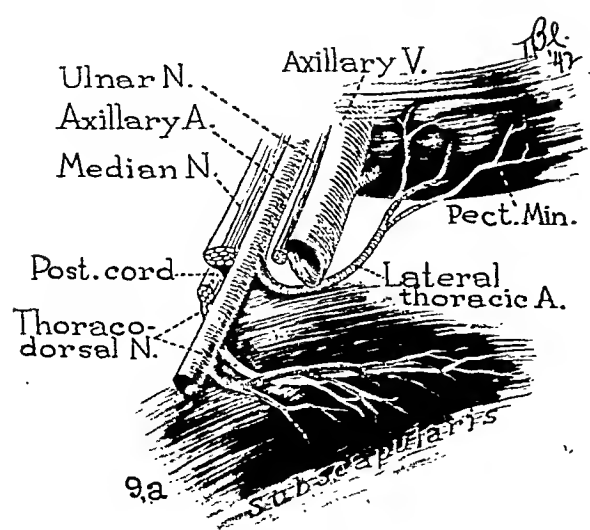
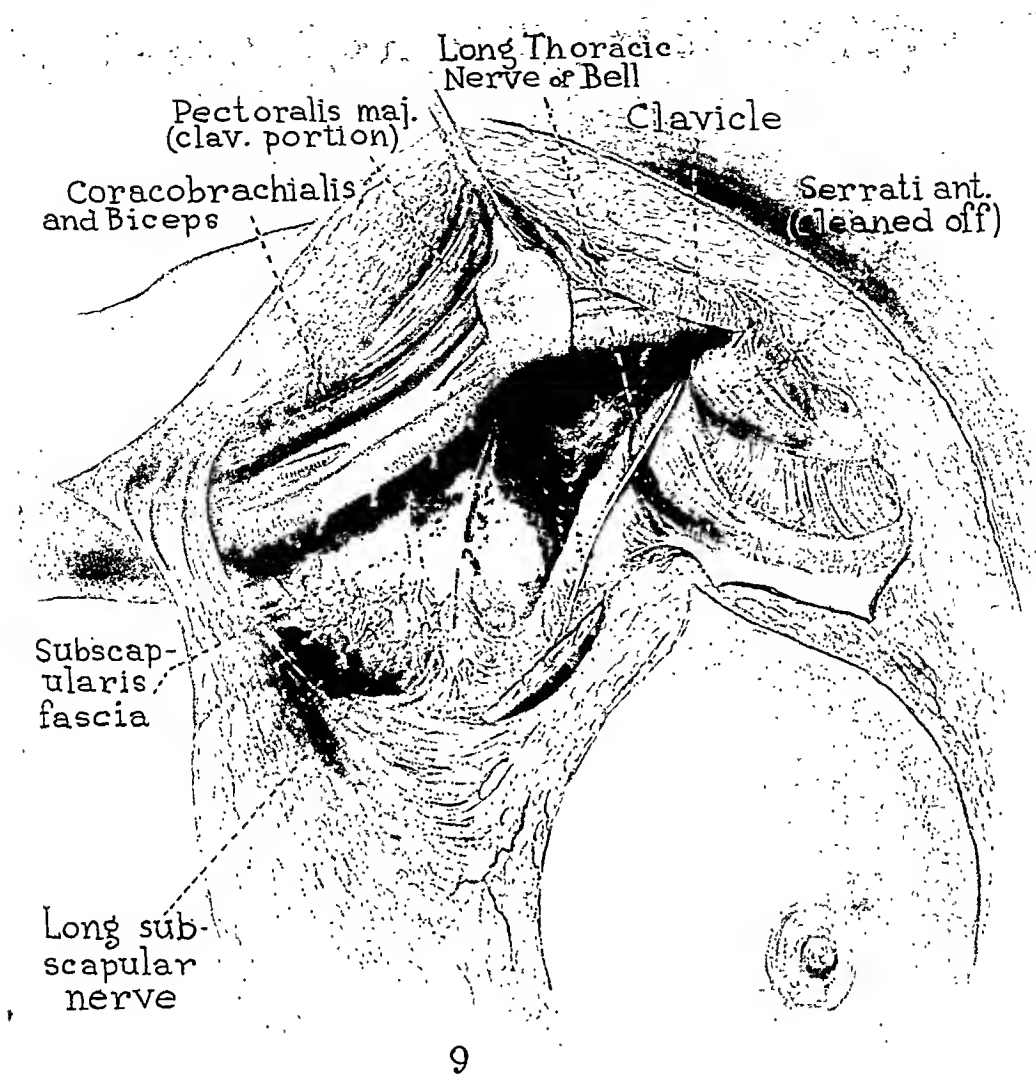


FIG. 9. Retraction of the axillary vessels and brachial plexus. Dissection of the apex of the axilla has commenced and the fascia of the lateral chest has been stripped down preserving the long thoracic nerve of Bell. a, the relative positions of the lateral thoracic artery (shown also in illustration 7) in comparison with the thoracodorsal nerve.

necessary to clamp the distal end as it does not bleed. (Fig. 4.)

The clavicular portion of the pectoralis

fascia is stripped downward and inward, thus exposing the brachial plexus. (Fig. 5.)

The fascia and areolar tissue over the

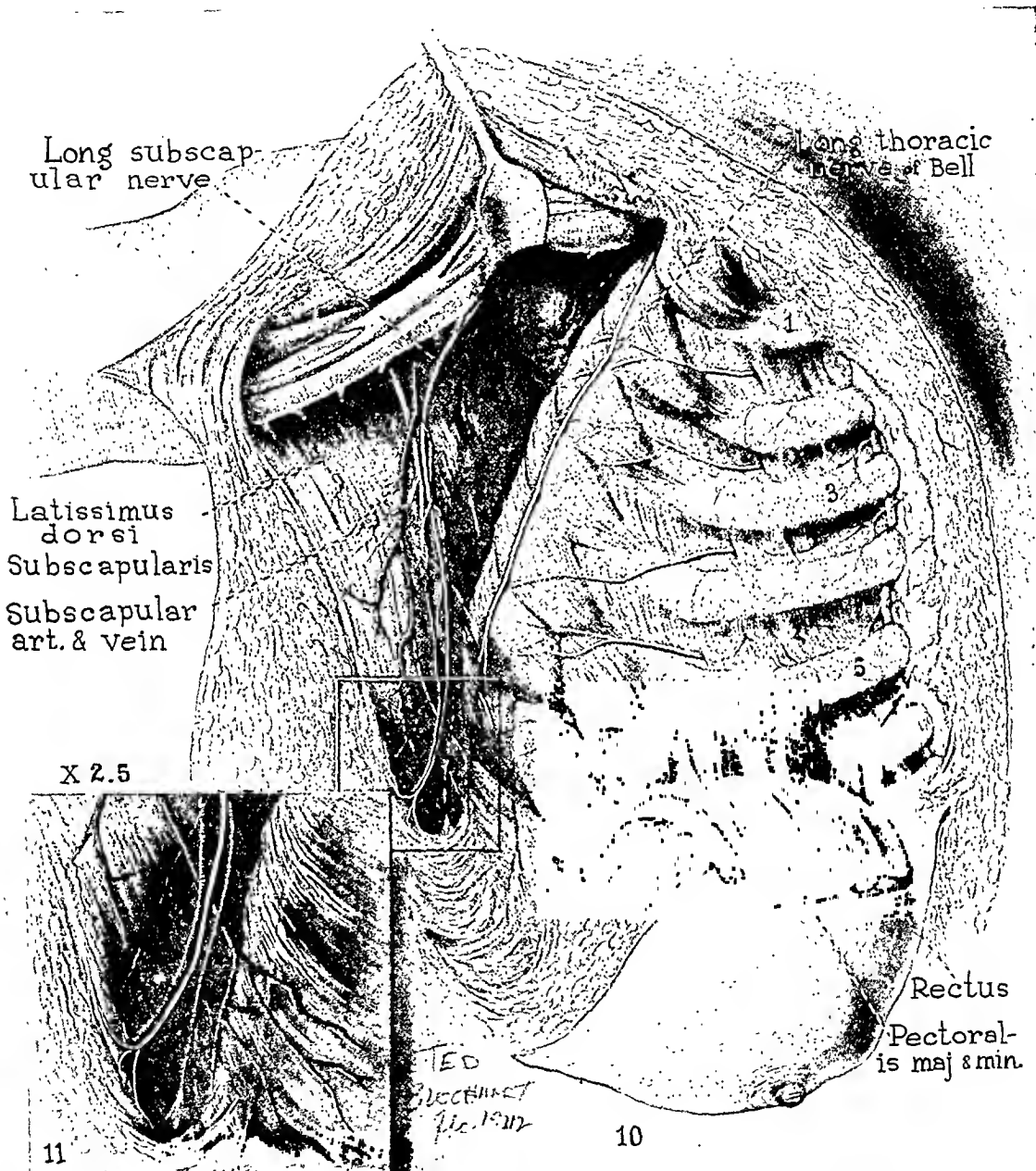


FIG. 10. The completed dissection of the axilla.

FIG. 11. The thoracodorsal nerve sends no branches to the chest wall but enters the latissimus dorsi. Branches of the subscapular artery go to the chest wall and may be sacrificed to facilitate the dissection of the lowest part of the axilla.

major muscle is then retracted upward, exposing the biceps and the costocoracoid muscles. (The coracoid process may be felt as a land mark.) The fascia over the border of these muscles (Fig. 5A) is incised and the

brachial plexus may then be lifted with a blunt Kelly forceps and incised. Commencing at the outer end and working inward, the anterior surface of the brachial plexus and axillary vein are cleared thoroughly

until the pectoralis minor muscle is reached. A finger is then hooked around this muscle and it is severed at its insertion into the coracoid process. (Fig. 6.)

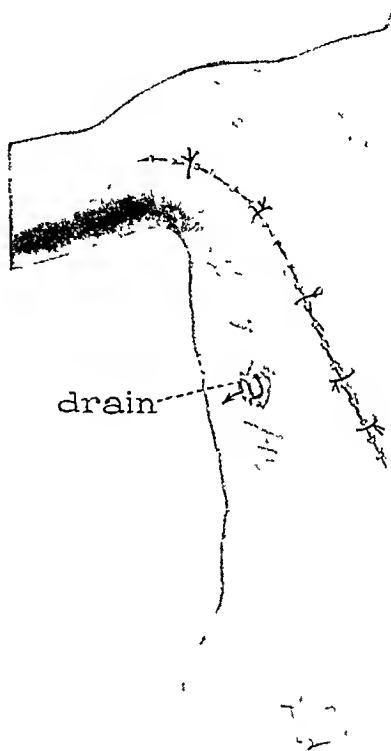
Continuing the dissection inward the branches of the thoraco-acromial artery, together with the internal and external anterior thoracic nerves, will be encountered and may be seen entering the pectoral muscles. These filaments are divided and the costocoroid membrane and areolar tissue cleared away. (Fig. 7.)

Next, the lower surface of the axillary vein is cleared, clamping and tying each tributary separately. The lateral thoracic artery is encountered here running toward and along the lateral border of the pectoralis minor. (Fig. 8.) When it is put on the stretch its blanch appearance resembles a nerve and may puzzle the surgeon. It will be seen to pass anteriorly into the muscles while the thoracodorsal nerve, for which it may be mistaken, is placed deeper and runs more posteriorly on the surface of the subscapularis muscle. (Fig. 9.)

The brachial plexus and axillary vessels are then retracted upward and beginning at the apex, the axilla is cleared from above downward. The chest wall is then dissected, first removing a thin layer of fascia with some fat and areolar tissue. Posteriorly, running on the chest wall, the long thoracic nerve of Bell will be seen and protected. Also digitations of the serratus magnus (anterior) will be noted.

Next, the fascia over the subscapularis is peeled off from above downward. If this is incised or divided with a forceps, it is surprising how easily the stripping may be accomplished. Toward the outer border of the muscle will be seen the subscapular vessels accompanied by the middle or long subscapular nerve (thoracodorsal). These structures are carefully cleaned downward, but it is not convenient to clear their terminal ends at this time. Immediately lateral to the subscapular muscle, the latissimus dorsi muscle courses from above downward. Retracting the axillary vein upward, the fascia over the muscle is

incised and stripped downward. No important structure is encountered here, so boldness is permissible and is time saving. (Fig. 10.)



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FIG. 12. The skin closed and the stab wound.

It is now time to complete the dissection of the axillary skin flap. This may be done boldly down to the outer border of the latissimus dorsi muscle. (The thoracodorsal nerve enters the medial border and is not in danger at this time.)

Dissection of the subscapularis and medial aspects of the latissimus dorsi is continued downward clearing the lowest point of the axilla. It may be noted that the thoracodorsal nerve is seen entering the latissimus dorsi and gives no branches to the chest wall while its accompanying vessels do so. These vascular branches to the chest wall are sacrificed which greatly facilitates the clearing of the lowest part of the axilla. (Figs. 11 and 12.)

The sternal skin flap is now completed and a very wide area of fascia is carefully

dissected off the chest wall, working from the periphery toward the breast. The fascia removed should include the fascia over the origin of the rectus abdominis and external oblique muscles and should cross the middle line as some lymphatics run in the center and dip down deeply at the ensiform process.

Stripping the chest closely, the dissection removes the multiple origins of the pectoral muscles. These are not clamped as previously because catching small bleeding points is preferable to leaving large "nubs" of tissue. When the lateral branches of the intercostal nerves are encountered, they must be divided. Undue tension should never be put on these, as perforation of the pleura could readily occur by so doing.

A stab wound is now made in the posterior flap for drainage and Penrose drains are inserted. (Fig. 12.)

Further undermining of the flaps may be necessary to get the skin edges to meet without too much tension. Making small cuts in the skin sometimes will relieve the tension sufficiently.

The closed wound should be dressed with large pressure pads, such as sea sponge or

sponge rubber. When this is followed by a tight adhesive binding all tissue spaces are obliterated and there is less chance of serum collections. The dressings need not be changed for at least two days.

*Postoperative Care.* The arm is elevated in abduction immediately and is moved passively and actively from the start to insure the early return of function. The patient is up out of bed on the third day and usually leaves the hospital in one week.

#### SUMMARY

1. Radical complete amputation is the best treatment for cancer of the breast.
2. The operator should become familiar with all anatomical landmarks of the thorax.
3. The operator should strive first for accuracy in dissection and then for rapidity.
4. Rapidity can be acquired by practice in following a definite plan of operation.
5. The various steps of procedure are given in outline form.

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# CORRECTION AND PREVENTION OF INTESTINAL ADHESIONS

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THE correction of intestinal adhesions has always been a difficult and serious problem to the surgeon because experience has shown us that adhesions have a tendency to recur following any operative procedure for its eradication.

Innumerable substances have been introduced into the abdominal cavity to prevent the contact of injured surfaces until healing can take place. Jones and McClure have enumerated these substances; gases, oils, nitrogen, air, salt solution, sodium citrate, olive oil, gelatin, paraffin, gumarabic, silver foil, gutterpercha, aminotic fluid, etc., but none of these substances have proved valuable in prevention of adhesions.

Many surgeons have made use of the omentum in many operative procedures, as I will shortly indicate, but I have searched the literature in vain for any procedure in which the omentum was used for the correction and prevention of intestinal adhesions.

Because of its abundance of lymphatic cells, the omentum has been compared to an enormous lymphatic gland. Its function is to protect the abdominal organs; Roux has aptly characterized the omentum as the "policemen of the abdomen." In abdominal inflammation, the omentum is of the greatest importance; by its pseudopodic-like movement it approaches and envelopes the affected organ in a protective manner and segregates it from the normal organs.

Experience and clinical observations have shown the importance of the omentum in scar tissue formation following injury or other inflammatory processes. In fact several authors have made use of the omentum to repair loss of substance, to reinforce the line of sutures or to favor hemostases of parenchymatous organs.

Blaye, Irvanow, and Pittoni have used the omentum to repair the loss of peritoneal substance. Enderlen and Suste have used omental flaps to repair wounds of the biliary tract, Greggio to repair necrotic ulcers of the small intestines; Bannet, Blaun, Henn, Zilocchi, Enderlen and Toraca have applied omentoplasty to perforation, ulceration and laceration of the intestine when the only other alternative was intestinal resection. Solieri has applied the omentum over a typhoid ulcer in a glove-like fashion to prevent peritonitis. Toro, of the Royal Clinic of Naples, has done a series of experiments in dogs; he produced incisional and bullet wounds of the intestines and without suturing the wounds he merely covered them with pedunculated omental flaps kept *in situ* with several sutures.

Iavone, assistant surgeon at the Surgical Clinics of Naples, performed two series of experiments: In the first series he produced cutting wounds of the colon, in the second series he produced necrosis of the colon. In all of the cases peritonitis was avoided by covering the lesions with omental flaps. It is obvious that omentoplasty can obviate intestinal resection, and operation that is always serious and with a high mortality.

Walters (Mayo Clinic) has successfully employed omental flaps in two cases of transperitoneal repair of recurring vesicovaginal fistulas. The omental flap was sutured between the vagina and the bladder, thus preventing the sutured openings from coming in contact and at the same time act as a patch over each. This technic occurred to him because of a previous case of a large chronic duodenal fistula with brawny induration about the fistula opening; here the omentum was sutured *en*

*masse* in the opening and primary union occurred.

Omentoplasty has been used in cholecystectomy to avoid adhesions between the liver and the stomach, to cover a perforation of the duodenum, cover and reinforce a carcinomatous area which was about to perforate, in perforating duodenal or gastric ulcers when the margins of the ulcers were necrotic and edematous and difficult to approximate. The omentum was sutured over the opening.

The omentum has been used in gynecology to cover the broad ligament for hemostasis after it had been freed from an adherent ovary. Omentum has also been used to cover the stump of the gallbladder after cholecystectomy and to cover the stump of the mesentery after extensive intestinal resection.

Omentoplasty is an excellent procedure for aid in surgical repair of structure in the upper abdominal cavity. It is not feasible in the lower abdominal or pelvic regions because the attachment of the omentum to the lower quadrant frequently causes traction of the stomach and may bring on an intestinal obstruction.

In all the omentoplasties mentioned a pedunculated flap not detached from the main organ was used. Senn was the first to use free omental graft to reinforce the line of sutures in intestinal resection. None of the authors has used free omental graft to correct and prevent intestinal adhesions. I have successfully used free omental graft to repair and prevent intestinal adhesions. This procedure is simple and not difficult and also very efficacious. I have used free omental graft on three cases.

#### CASE REPORTS

The first case was a man, aged forty-five, admitted by ambulance to Columbus Hospital. He had a mass in the pelvis consisting of several loops of adherent ileum. This mass was adherent anteriorly to the lower portion of the sigmoid. This mass was gently separated from the bladder and sigmoid, and the adherent

loops of ileum forming the mass were freed. The involved ileum was about twelve inches long and practically devoid of serosa. I applied seven pieces of free omental graft to the raw surfaces of the ileum and to the bladder and sigmoid to avoid the recurrence of adhesions. The portions of omental graft ranged in size from one and a half to three inches. The patient made an uneventful recovery and twenty months after the operation had no symptoms or signs of intestinal adhesions.

The second case was a young woman, twenty-one years old, who had an appendectomy three years before admission and three months before admission had been operated upon for gallbladder symptoms. On the operating table the gallbladder was found to be normal but there were adhesions about the cecum which were removed. The present admission was through the out-patient department with a diagnosis of intestinal adhesion.

On opening the abdomen the cecum and ascending colon were plastered against the peritoneum and were inadvertently cut through the serosal and muscularis coat, denuding an area of three by seven inches before the error was realized. I applied a free omental graft over the denuded portion of cecum and colon. The patient is well and has had no complaints since the operation one year ago.

The third case was a seventeen-year old boy admitted for intestinal obstruction. At operation the jejunum was found bound down to the postabdominal wall by a large adhesive band. After relieving the jejunum of this band it was found that the serosal and muscularis coats originally beneath the adhesion were completely destroyed. To avoid resection of this portion of jejunum a free omental graft was applied to the denuded area held in place with several sutures. The patient made an uneventful recovery and has been well for the past five months.

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# A METHOD OF CONTROLLING SUDDEN, PROFUSE HEMORRHAGE FROM THE SPLEEN

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OF the methods for controlling hemorrhage from the spleen by ligation of the splenic artery proximally, that does not hamper the surgeon at all. That this method is effective in controlling bleeding is evidenced by the following cases:

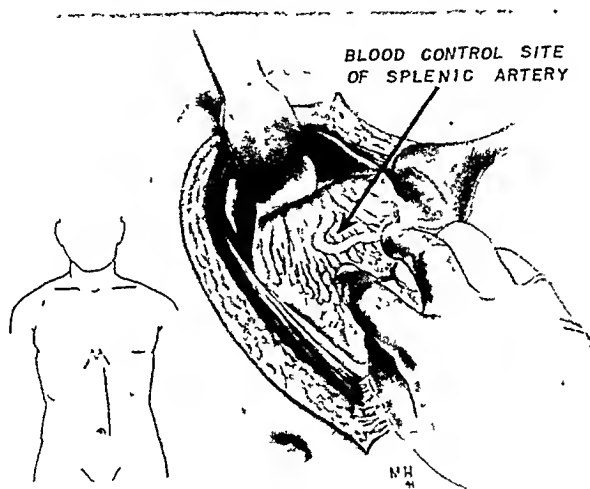


FIG. 1. This diagram illustrates site of splenic hemorrhage.

described by Miller\* is the most recent. This method exposes the splenic artery near its origin and utilizes a temporary tourniquet. All methods of this type presuppose a clear field and sufficient time to carry out that dissection. In the presence of extensive hemorrhage these methods are not feasible and therefore a simple, effective and quick procedure is herewith described.

With the abdomen open, the stomach is drawn downward and to the left by traction with the hand along the lesser curvature. This maneuver enables one to palpate the splenic artery and to apply direct pressure against it at its origin in the celiac axis. For a tampon, a sponge rolled into a firm ball and held in a large Ochsner clamp is employed by the assistant. (Fig. 1.) This instrument takes up so little space that it

## CASE REPORTS

CASE 1. B. S., a nine-year old white male, entered the hospital on January 31, 1939, about seven hours after his sled struck a tree while coasting. About an hour after admission, operation was performed through a muscle-splitting incision. The peritoneum was opened and at first no blood was encountered but suddenly there was a gush of blood which came from the left upper quadrant. The major portion of the spleen was found lying free in the peritoneal cavity. Bleeding continued to an alarming degree until it was controlled by digital pressure against the splenic artery along the upper border of the pancreas. Finally, the remaining portion of spleen, measuring 3 by 3 cm., was found attached to the pedicle which was ligated. Bleeding was controlled and the abdomen was closed in layers.

Comment. Bleeding could be controlled completely by digital pressure against the

\* MILLER, EDWIN M. J. A. M. A., 112: 220, 1939.

splenic artery, but a sponge tampon would have been more practical because it would not have encroached as much upon the operative field.

CASE II. S. U., No. 48625, was operated upon for multiple splenic abscesses. During the exploration, a large cavity was broken into with the evacuation of a purulent material followed by a profuse hemorrhage. The assistant controlled the bleeding immediately by pressure on the splenic artery with the sponge

tampon while the surgeon enlarged the incision and packed the cavity under direct vision and without further hemorrhage.

#### SUMMARY

An effective method for controlling bleeding from the splenic artery has been described. It is particularly valuable in severe hemorrhage from the spleen. Two illustrative cases are reported.



HIRSUTISM may occur in connection with certain ovarian disturbances. It is not infrequent after the menopause and also occurs with other instances of amenorrhea. This must not, however, be hastily attributed to ovarian dysfunction alone.

From "Symptoms in Diagnosis" by Jonathan Campbell Meakins (Little, Brown and Company).

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# Case Reports

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## EXTRAGENITAL CHORIO-EPITHELIOMA IN THE MALE WITH ASSOCIATED GYNECOMASTIA\*

### REPORT OF A CASE

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THE occurrence of a chorio-epithelioma of extragenital origin in the male has been denied in particular by both Prym and Oberndorfer, who insist that such a tumor is always consequent upon a primary tumor of the testis. Thorough examination of the genital tract, including microscopic examination of the testes, with negative findings of a primary tumor of the testis, is considered by Prym to be the only positive proof of an extragenital origin of such a growth.

The case to be reported herewith fulfills the strict criteria of Prym, emphasized especially by Kantrowitz, Gerber, Wineberg and Erdman, Brown, and Shaw, all of whom have stated that negative serial block sections of the testes are necessary to prove the extragenital origin of a chorio-epithelioma in the male. In addition we would stress the importance of adequate hormonal studies believing that such studies are necessary for further proof that the growth is actually of chorionic origin. In our case we were refused permission to investigate the pituitary at the postmortem examination, hence we are unable to offer any microscopic examination of this gland, but we are able to supply the results of other hormonal investigations. The occurrence of gynecomastia, as an associated condition, usually bilateral, with glandular

tissue hyperplasia is important. It is often the only clinical symptom, according to Gilbert, and our case presented gynecomastia, single at first but later bilateral.

Melicow, in discussing teratogenesis, states that in order to nourish the developing embryo, the outer cells (blastomeres) become specialized early into chorionic epithelium. The penetrating power of these cells is marked—a characteristic which is probably the most important factor in the invasiveness of malignant tumors containing these cells. The first blastomeres are toti-potent and any one cell can form a new individual. If segregated and included within the developing testis, such a cell or cells may at a later date be activated, then multiply and form a neoplasm containing embryo-like structures and chorionic epithelium (trophoblast). By such a process either embryoma of the testis, embryomatosis of testis, or chorio-epithelioma may be formed, and may be associated with either embryo-like tissues, chorionic cells, chorionic gonatropin or gynecomastia.

Melicow states that these neoplasms are presumed to arise from so-called trophoblastic cell-rests and may be included within the testis. Gerber states that extragenital chorio-epitheliomas in males are considered to develop from germinal rests or as malignant transformations of tera-

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tomas, and are commonly found in the mediastinum or in the retroperitoneal region along the course of the urogenital



FIG. 1. Lung, bisected, displaying globular metastatic tumors. Note necrotic centers. Weight of both lungs, 4,020 Gm.

anlage. The concept of origin from misplaced testicular rests has had additional support recently in the findings of Staemmler, who reported the occurrence of such rests in the retroperitoneal fat at the root of the mesenteric vessels. He believed that they represent rests of the plica urogenitale, and inasmuch as this structure extends from the sixth thoracic to the second sacral segment in the embryo, this author believed that germinal rests may also be found in the mediastinum in the adult. Erdman states there is a distinct possibility that the primary focus of any extragenital chorio-epithelioma may be located at the hilus of the lung via a remnant of the urogenital fold persisting in the region of the thoracic segments.

As to the possibility of a healed testicular tumor with later chorio-epitheliomatous metastases there is evidence to support such a premise. Prym has described such a possible case: The microscopic examination of the testicular nodule, after complete spontaneous healing or regression by sclero-

sis thereof, revealed only elastic and connective tissue fibers, yet the patient died of chorio-epitheliomatous metastases. In addition may be quoted the views of Craver and Stewart who believe that those cases, in which the apparent primary tumor lies distant to the genital tract, actually represent a metastases via the circulatory route with a healed primary lesion in the testis. They cite an instance of a demonstrable cholesteatoma as evidence that such regression of the primary tumor can occur.

There are some thirty articles in the literature in English, French and German, reporting cases of extragenital chorio-epithelioma in the male. However, with five exceptions, all these reports may be discredited on the basis of either no microscopic testicular examination, incomplete examination or no autopsy. Cases which pass muster with one author fail to do so with another, but all reports except five fail to adduce conclusive evidence of extragenital origin on the basis of negative block serial sections of the testes.

Thus there are five reported cases of extragenital chorio-epithelioma reported, all having had negative serial block sections of the testes. In these five cases the primary sites were: Fenster, retroperitoneal; Kantrowitz, superior mediastinum; Gerber, retroperitoneal, lower right; Wineberg, bladder; Erdman et al., retroperitoneal, left infrarenal.

As to hormonal studies in these five cases a positive Aschheim-Zondek reaction, done on the urine was found in the cases of Kantrowitz, Gerber and Wineberg, a negative reaction in Erdman's case and tests were not made in Fenster's case. As to the studies for gonadotropic or estrogenic activity made on extracts of the tumor or metastases thereof, negative results were found in the case of Wineberg. These examinations were apparently not done in three cases. However, in the fifth case (Kantrowitz) alcohol extract for anterior-pituitary-like hormone, with 1 cc. equivalent to 9.5 Gm. of tumor tissue gave

positive findings in two mice with 1.2 cc. and negative results in one mouse with 1.5 cc. In tumor tissue (lung metastases), using

to the medical service of Dr. Kenneth Gordon on August 21, 1940, because of a swelling of the left side of the neck, first observed



FIG. 2. Spleen, external and bisected views. Contained one subcapsular metastasis, measuring 2 cm. in diameter.

ether extract for the female sex hormone, negative results were obtained with 20 Gm. of tissue.

Gynecomastia was present in Fenster's case, but true gynecomastia was apparently absent in the case of Erdman, wherein removal of supposed breast tumor had been done six months before he saw the patient, the pathologic diagnosis being low-grade fibro-adenoma, diffuse. Erdman remarks that pathologists have been prone to diagnose the gynecomastia as fibro-adenoma of the breast. In the other three cases, the presence of gynecomastia is not mentioned in the original report and thus is assumed to have been wanting.

Fundamentally, therefore, we believe that proof of an extragenital chorio-epithelioma in the male requires, first, negative serial block sections of the testicles, second, the finding of lung, mediastinal or liver or other extragenital tumors presenting the characteristic microscopic morphology of choriocarcinoma, and third, the proof by hormonal studies of the presence in the urine, or by the assay of the tumor tissue, of abnormal amounts of the sex hormones.

#### CASE REPORT

A male, thirty-four years of age, entered the Los Angeles County Hospital, being assigned

eleven days previously and a swollen and tender right breast of fourteen days' duration. The neck swelling produced a feeling of choking and pressure upon his trachea, pronounced during the day but not noticed at night, sleep being undisturbed. The swollen breast recalled to the patient the fact that the same breast had been similarly affected five years previously, tenderness being more marked. Subsidence of this swelling had been prompt without any complications or treatment. The patient stated that, at fourteen years of age, he was kicked by a horse, resulting in prompt and extensive swelling of one testicle, subsidence occurring after several weeks. He did not remember which testis was affected nor whether there had been a traumatic rupture of the testis.

The essential findings, upon physical examination, were related to the neck and the right breast. In the left cervical area, there was a nontender mass approximately 8 by 10 cm., just posterior to the middle aspect of the clavicle, this mass being somewhat fixed and nodular in outline. The mass extended downward to a small extent behind the clavicle and also upward, where it occupied a position immediately beneath the sternomastoid. An audible bruit could not be heard nor were pulsations apparent. The trachea was in the midline and no other masses elsewhere could be found. The right breast was enlarged, the center of such swelling being the nipple and the area involved being approximately 2.5 by 3 cm. The breast was tender only to touch and not

fixed. There was no secretion. The area of breast swelling was considered to represent gynecomastia, not a tumor. Because of the

but discarded because of the repeated examinations of the testes without the findings of a primary testicular tumor.



FIG. 3. Normal male breast. ( $\times 80$ ).

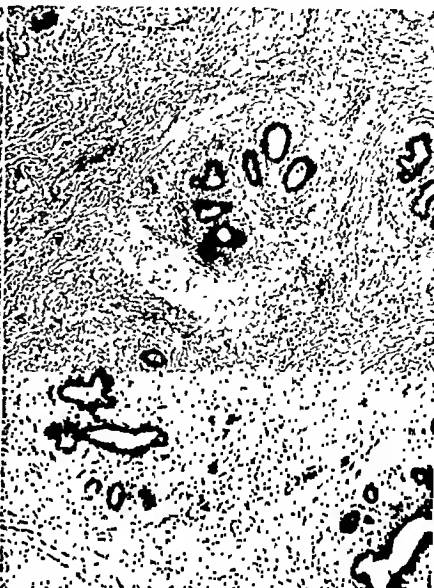


FIG. 4. Gynecomastia. Note the increase in number of ducts and their complexity, also the marked cellularity of the stroma in the breast with gynecomastia in contrast to the structures in the normal male breast. ( $\times 80$ ).

presence of gynecomastia, the testicles were examined most carefully and repeatedly for the presence of a primary tumor of the testis, but no such tumor could be palpated.

X-ray examination, done one week after hospital entrance, disclosed single nodes 2 cm. in diameter in the right and left lung fields consistent with metastases; no mediastinal mass was found. The hemoglobin was 87 per cent red blood cells 5,400,000, white blood cells 14,000, neutrophils 74, lymphocytes 21, mononuclears 5. One week later the hemoglobin was 110, the red cells 6,100,000, and white cells 19,800. Sternal puncture was done, no essential change being found except "marked hyperplasia which is chiefly of the myeloid series; immature forms are entirely normal, a few cells having the earmarks of reticulo-endothelial cells were found. The conclusion from these findings was that the bone marrow was being secondarily stimulated by an unknown agent. The tumor in the neck may be a lymphoblastoma which can cause such stimulation. There is no invasion of bone marrow." Needle biopsy of the neck tumor was reported "tissue not recognizable."

The diagnosis at this time rested between a lymphoblastoma, sarcoma or aberrant thyroid carcinoma, primary in the neck with pulmonary metastases. Chorio-epithelioma was considered

Operative investigation of the neck was done primarily for biopsy and the tumor when exposed was dark, reddish-brown in color, very vascular and firmly fixed to all contiguous important structures. The tumor was the size of a small orange, extending beneath the clavicle for at least one inch and upward to the angle of the jaw. The growth was thought to be carcinoma of an aberrant thyroid gland, but in view of the intimate and firm fixity to neighboring important structures and the known presence of metastases, an attempt at removal seemed contraindicated. However, an adequate portion of the growth was removed by the radio knife for microscopic examination. The pathologist reported a rapid frozen section showed: "highly malignant tumor with dark very large nuclei, evidently carcinoma but of unknown origin. The tumor resembles chorio-carcinoma having much hemorrhage and very anaplastic cells. There is no resemblance to thyroid. The diagnosis is metastatic choriocarcinoma."

*Biological Examinations.* A Friedman test, done on the urine six days after operation, was

positive. A prolan estimation done on the urine shortly thereafter showed over 10,000 rat units and less than 100,000 rat units. The hormone

time showed fist-sized pulmonary metastases. Both breasts were enlarged, slightly tender to touch but there was neither secretion nor cir-



FIG. 5. Normal male breast of man of thirty-six. Note mature collagenous fibrous stroma. ( $\times 235$ .)



FIG. 6. Patient's breast: gynecomastia. Note increased ducts and immature cellular fibrous stroma. ( $\times 235$ .)

assay of the tumor tissue by Dr. S. Glass secured at autopsy showed: estrogen—one rat unit per 1,000 mg. of tissue; prolan—one rat unit per 500 mg. of tissue. Thus the lung tumor, on the basis of the weight at autopsy (since the tumor involved practically all lung tissue) could be considered as weighing at least 3,000 Gm., since the lungs weighed 4,020 Gm. Thus the estrogen present in the lung tumor would approximate 3,000 rat units and prolan 6,000 rat units.

*Progress of the Patient.* The patient was given x-ray treatment in adequate dosage, eleven treatments in all being administered, the areas being the left neck and chest. The neck tumor was reduced one-third in size within the first ten days of treatment but rapidly regained its original size after the completion of treatment and remained at that size. X-ray of the chest at this time, a left oblique film being made, showed that the nodes previously found, were undoubtedly intrathoracic and consistent with pulmonary metastases.

The patient was dismissed on October 19th but readmitted on November 19th, with the complaint of severe pain in the left chest, marked dyspnea and hemoptysis. X-ray at this

cumscribed masses, and the enlargement was considered as bilateral gynecomastia. The patient continued a rapid downhill course, symptoms of mental aberration being present (brain metastases?) for the week prior to death, which occurred on January 11th. Permission for a limited autopsy was obtained, the head, face and neck not to be included in the examination.

*Résumé of Essential Autopsy Findings.* A thorough and complete autopsy, done by Dr. S. Katz, exclusive of head, face and neck was made, but herewith are presented only the essential and important findings.

In the left side of the neck there was palpable a large, firm, fixed, mass which lay beneath the sternocleidomastoid muscle and was 8 by 6 cm., in size. No other lymph adenopathy was palpable in the neck.

The breasts were enlarged to a size approximately 6 cm., in diameter and at least 2 to 3 cm. in thickness.

*Respiratory System.* There were scattered areas of adhesive pleuritis diffusely over both lungs, firmly holding the lungs to the chest wall. The right pleural space, however, contained approximately 300 cc. of bloody fluid pocketed

in between these adhesive bands. The left lung weighed 2,040 Gm. and the right lung 1,980 Gm. The external surface of both lungs showed



FIG. 7. Lung metastasis. Shows characteristic tumor structure. A, Langhans' cell type; B, syncytial cell type; C, necrotic tumor cells. ( $\times 235$ .)

a large number of various sized nodules which were harder in consistency than the intervening relatively normal lung tissue. The cut surface of each lung showed innumerable nodules, varying in size from 0.5 to as large as 10 cm. These nodules were all spherical and the cut surface showed a spongy tissue, hemorrhagic in appearance, with central necrosis of the nodules. The tracheobronchial lymph-nodes showed a few enlarged nodes, the maximum diameter being 2 cm. and these nodes had a cut surface which showed very finely granular, grayish-white tissue which was soft in consistency and not unlike tumor tissue.

**Liver.** The liver weighed 2,120 gm. Its cut surface showed normal liver tissue and multiple sections showed no grossly evident tumor metastasis.

**Spleen.** The spleen weighed 170 Gm. Its cut surface appeared normal except for the presence of a nodule 2 cm. in diameter near the hilus. This nodule on section was spongy, hemorrhagic and resembled the tumor tissue present throughout the lungs.

**Lymph-nodes.** The lymph-nodes throughout the body were entirely normal with the excep-

tion of the changes in the above mentioned tracheobronchial nodes. There was also present one node lying posteriorly to the aorta 5 cm. above its bifurcation. This node was approximately 3 by 1 cm. in size and its cut surface showed a grayish-white, smooth, finely granular soft tissue similar to tumor tissue.

**Urinary System.** The kidneys were bilaterally equal in size, were in the usual position, and together weighed 370 Gm. Their capsule stripped with ease exposing smooth kidney tissue. The cut surface showed an entirely normal renal parenchyma. The pelves and ureters were grossly normal. The urinary bladder was entirely normal.

**Genital System.** The external genitalia were those of a normal male. The testes were in the usual position and were approximately the usual size. The cut surface showed no gross changes. The prostate was of normal size. Its cut surface demonstrated no gross pathological condition. Seminal vesicles were normal.

**Endocrine System.** The suprarenal glands were the only endocrine glands examined. They were of the usual size and normal on gross appearance. No tumor metastasis was apparent.

**Microscopic Findings: Testes.** Serial sections in paraffin were made of the entire bodies of both testes (sixty-two sections in all). The general microscopic structure was comparatively normal in appearance, with the exception of moderate atrophic changes in the seminiferous tubules. Very few normal appearing sperm could be found in any of the tubules.

An area of complete atrophy of the tubules and replacement by soft fibrous tissue was present in one testis. This area was of uncertain shape and about 1 cm. in maximum diameter. It was located in the hilar region of the testis. The area contained a moderate number of small round cells, apparently of chronic inflammatory origin including a considerable proportion of typical plasma cells.

In no part of the testis was there found any tissue, suggestive of a neoplastic character.

**Mammary Glands.** Sections of the enlarged mammary glands presented an abnormal structure as compared with the structure of normal breasts of a man of approximately the same age. These changes included a marked increase in size of the organ with numerous branching ducts and in places imperfectly formed gland acini. Ducts and acini were lined by columnar epithelium, appearing "pseudostratified." The

interductal stroma was composed of fibrous tissue which was distinctly more cellular than that of the normal male gland.

*Lungs.* Sections made from the enormous

# SUMMARY

A case of extragenital chorio-epithelioma in the male is herewith reported. This case,

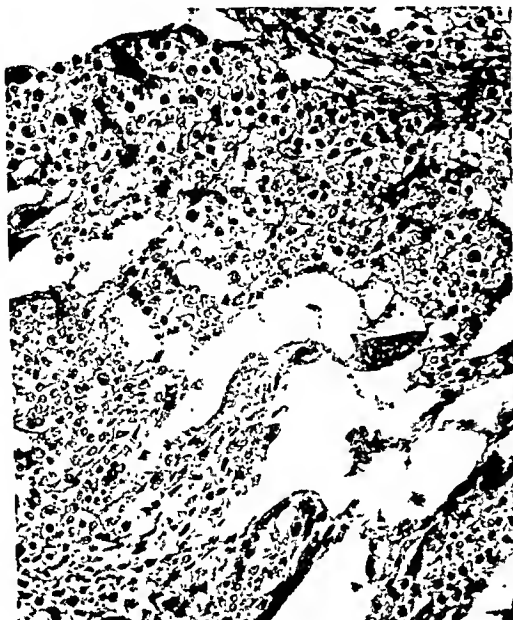


FIG. 8. Lung metastasis. Characteristic small Langhans' cells with single nuclei and several large multinucleated eosinophilic syncytial cells. ( $\times 235$ .)



FIG. 9. Minute metastatic tumor nodule in retroperitoneal lymph-node. ( $\times 235$ .)

tumor nodules of the lungs presented a structure strikingly resembling that of the chorio-carcinomatous tumors, usually primary in the uterus, including specifically the two types of epithelial structure which characterize the so-called trophoblast of the chorionic villi—the “syncytial” layer of cells and the “Langhans” cells. Much free blood was present in the tumor tissue and the necrotic changes were so extensive as to make it difficult to find typical areas of living tumor tissue. These were confined to the peripheries of the tumor masses.

*Spleen.* The metastatic tumor nodule in the spleen was 2 cm. in size. The microscopic structure was similar to that described in the lung with marked necrotic changes.

*Lymph-nodes.* The mediastinal nodes (tracheobronchial) which were enlarged (2 cm.) contained tumor masses microscopically similar to those described in the lungs and spleen. Smaller areas of tumor tissue were present in the one retroperitoneal node.

Sections of kidney, liver and prostate gland showed no notable changes and did not contain tumor tissue.

presumably the sixth on record, apparently fulfills the criteria necessary for proof of an extragenital origin, viz., first, negative serial block sections of the testes. Sixty-two

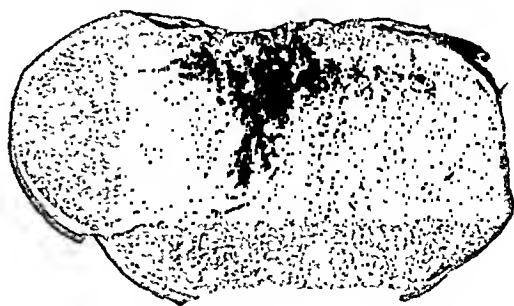


FIG. 10. Section through corpus of testis. The dark irregular area represents the scarred portion in which seminiferous tubules are absent. ( $\times 5$ .)

such sections were made in this case without the finding of a primary testicular tumor. There was an area in one testis which showed a scar, but no where in this testis was to be found any tissue suggestive of malignancy. It is possible that the scar

in one testis may be related to the traumatic inflammation or even rupture of this testis, resulting from the kick of a horse received at fourteen years of age.

Second, at autopsy in this case, chorio-epitheliomatous tissue was found in the lungs, mediastinal and tracheobronchial nodes, spleen and in a solitary retroperitoneal lymph-node.

Third, abnormal amounts of the sex hormones were found in the urine and in the tissue of the chorio-epitheliomatous masses in the lungs.

Fourth, a true gynecomastia was present in both breasts.

#### CONCLUSIONS

Since Prym has reported a possible case of spontaneous healing or regression of a primary testicular tumor with the death of the individual from chorio-epitheliomatous metastases later, we are quite willing to acknowledge the possibility of such a state of affairs in our case, in view of the findings of a scar in one testis. We are unable to state the site of the primary tumor definitely; yet in view of the facts that the reported case fulfills the very exacting criteria of proof of extragenital origin, we are more inclined, particularly in view of the fact that early x-ray showed two areas of undoubted chorio-epithelioma in the lungs, to accept Erdman's suggestion that "there is a distinct possibility for the primary focus of an extragenital chorio-epithelioma to be located at the hilus of the lung via a remnant of the urogenital fold persisting in the region of the thoracic segments."

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# ABSCESS OF THE TONGUE

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**A**N acute abscess developing within the substance of the tongue is admittedly a rare condition. Many surgeons of wide experience have never been called upon to treat such a patient, and large, general hospitals may not in years record such an instance. The following case is therefore reported together with a review of the pertinent literature on this subject:

## CASE REPORT

R. E., a farmer, age twenty-six, was admitted to the Methodist Hospital, Omaha, Nebraska, on September 6, 1941, complaining of pain and swelling in the tongue, inability to close his mouth and difficulty in swallowing.

Prior to the onset of the present illness, he had enjoyed excellent health, and considered himself well until the onset of his present symptoms. He did admit to the habit of chewing upon straw on many occasions.

Three days before admission, the patient found upon arising in the morning that his tongue was swollen and painful. This gradually increased during the following two days until this organ completely filled the oral cavity, and made it impossible for him to close his mouth. It was impossible to take any form of solid food and liquids were swallowed with great difficulty. Pain persisted in the tongue, beneath the right mandible and radiated to the right ear. Excessive salivation was constantly present and troublesome.

Examination showed a rather heavy set young man of stated age, who appeared moderately ill. The temperature was 102.6°F., pulse 110 and respirations 24. Pertinent physical findings were limited entirely to the local lesion. The patient's tongue was seen to be tremendously enlarged, filling the entire oral cavity and prohibiting closure of the mouth. The swelling was diffuse, but it was seen to be somewhat more marked on the right side than on the left. The tongue was brawny and

reddish-brown in color. It was quite tense and indurated and its lateral surfaces were covered by a heavy coat of fibrin. It was impossible to visualize the oropharynx. Digital examination showed no edema in the floor of the mouth and there was no induration or swelling in the neck. A few soft glands were palpable at each angle of the jaw. One area of questionable fluctuation was found on the lateral aspect of the tongue near its base.

The hemoglobin was 87 per cent, the erythrocyte count 4,480,000, and the leukocytes numbered 16,300. The urine was negative. A primary diagnosis of abscess of the tongue was made and surgical drainage advised.

Under novocain infiltration anesthesia, the right side of the tongue was aspirated on its lateral and superior surfaces without success. Further exploration revealed a soft area on the undersurface of the tongue at its junction with the floor of the mouth on the right side. Aspiration here yielded thick, gray pus. A 2.5 cm. incision was then made into this abscess cavity, which was seen to extend up into the muscles of the tongue but did not appear to penetrate beyond the midline. Approximately one ounce of thick, purulent material with a foul odor was obtained. No drain was inserted. Culture of the pus showed a mixed growth with streptococci and pneumococci predominating.

Improvement was quite dramatic and within twenty-four hours the swelling of the tongue had noticeably subsided. The patient was encouraged to use hot antiseptic mouth wash at frequent intervals, and local irrigations of warm saline solution were used to facilitate drainage. Sulfathiazole was given in 15 gr. doses every six hours for two days. The patient continued to make a satisfactory recovery and was dismissed from the hospital on the fifth postoperative day. At this time the swelling of the tongue had almost disappeared except for some induration about the site of the incision.

## INCIDENCE

Bennett,<sup>1</sup> in 1906, found a total of 145 cases of abscess of the tongue reported in the literature, the first case being recorded in 1816. Grigsby and Kaplan<sup>2</sup> found a total of twelve cases in the American literature, and twenty in the foreign literature during the twenty-year period preceding 1937. In the five-year period from 1937 to 1942 we have found additional reports of two cases in the American literature and five in foreign periodicals. These previously compiled series, together with the case here presented, gives a total of 183 cases reported to date. It is interesting to note that few authors have observed more than one or two cases, the vast majority appearing as single reports. While it is impossible to conclude that this condition is as rare as these statistics would indicate, its occurrence must be considered quite infrequent.

## ETIOLOGY

Many factors may contribute to the development of a lingual abscess. Butlin and Spencer<sup>3</sup> in their monograph on the tongue considered chilling and acute sore throat the most frequent predisposing factors. Barlow,<sup>4</sup> Wilensky and Harkavy,<sup>5</sup> and Hansel,<sup>6</sup> and Salinger,<sup>7</sup> all report cases developing during the course of an acute pharyngitis. Mahoney<sup>8</sup> observed two cases, one appearing after tonsillectomy performed under local anesthesia, and a second following extraction of a molar tooth. Raynor's<sup>9</sup> case developed following a submucous resection while that reported by Waldapfel<sup>10</sup> appeared as a complication of a primary infection of the circumvallate papillae. Loeb,<sup>11</sup> Cavanaugh,<sup>12</sup> and Vandever<sup>13</sup> have all observed patients in which the abscess developed without any preceding infection or known trauma. The fact that these patients are usually males in young or middle adult life and are seen more frequently during the winter months suggests that upper respiratory infections and trauma are the most common etiological agents.

## PATHOLOGY

There are several anatomical and physiological reasons why an acute suppurative process rarely develops within the substance of the tongue. The principal ones which have been suggested are: (1) The firmness and resistance of the mucosa of the tongue characterized by a large amount of cornified epithelium at the summits of the filiform papillae (Wilensky and Harkavy,<sup>5</sup> Grigsby and Kaplan);<sup>2</sup> (2) anatomical structure of these papillae from multiple secondary papillae of firm connective tissue each with an independent and abundant blood supply (Grigsby and Kaplan);<sup>2</sup> (3) practical absence of a subcutaneous areolar tissue (Wilensky and Harkavy);<sup>5</sup> (4) very compact musculature with exceptionally rich blood supply (Grigsby and Kaplan,<sup>2</sup> Prenn,<sup>14</sup> and Cavanaugh);<sup>12</sup> and (5) local immunity as a result of constant exposure to the varied bacterial flora of the mouth (Prenn).<sup>14</sup>

Butlin and Spencer<sup>3</sup> have outlined four classical forms in which an acute interstitial infection of the tongue may present: (a) Acute parenchymatous glossitis; commonly seen following exposure to cold or an acute upper respiratory infection. Frank supuration with abscess formation is not the rule although it may occur. (b) Streptococcal glossitis characterized by an extreme amount of local edema and danger of extension to the neck, glottis, lungs and pericardium. (c) Staphylococcal glossitis in which this organism is the principal offender with an extensive local inflammatory process limited to the tongue. The development of a frank abscess is the usual result. (d) Acute gangrene of the tongue seen principally as a complication of the contagious diseases, nonspecific lingual ulcers and certain of the tropical fevers.

Of these four types staphylococcal glossitis probably represents the most frequent form encountered. The responsible bacteria isolated by different observers show a wide variety of organisms, usually appearing in mixed culture. Staphylococci, streptococci and diphtheroid bacilli are frequently

mentioned while in our own case streptococci and pneumococci appeared predominant in the mixed culture. Although inspection of the involved tongue suggests that the suppurative process involves the entire organ, the actual abscess is usually found to be limited to one side by the median raphe. For some unexplained reason the majority of cases appear to involve the left side of the tongue and tend to point toward the lateral edge at its junction with the floor of the mouth.

### SYMPTOMS

The symptoms which characterize an abscess of the tongue may develop without warning or may follow an acute respiratory infection, trauma to the tongue or some oral surgical procedure. Stiffness of the tongue is usually the first symptom, followed by pain which may be localized in the tongue alone or referred to the pharynx, ear or cervical region of the neck. Prenn<sup>14</sup> describes a case in which the initial pain simulated *tic douloureux*. This he explained on a basis of innervation since the lingual nerve supplying the anterior two-thirds of the tongue with sensation connects with the auriculotemporal of the third division of the fifth cranial nerve, while the glossopharyngeal nerve supplying the posterior third of the tongue with sensation sends off the tympanic branch. Hansel<sup>6</sup> also reports a case in which pain was trigger-like in character, referred to the ear and pharynx and precipitated by swallowing cool fluids. Cocainization of the nasal ganglion gave relief until a definite localized abscess developed in the tongue which was relieved by surgical drainage.

With the onset of pain, swelling appears and progresses rapidly until the entire oral cavity is filled by the tremendously enlarged tongue. Swallowing becomes difficult, closure of the mouth is impossible and constant salivation is the rule. After several days have elapsed, the tongue becomes covered with a dirty, greyish-brown exudate, the breath becomes fetid and fre-

quently the cervical lymph-nodes are found to be enlarged and tender.

The systemic reaction is of moderate intensity with the temperature ranging from 100° to 102°F. with a commensurate elevation in the pulse. A leukocytosis of moderate degree is almost constantly found.

### DIAGNOSIS

During the first few days after the onset of pain in the tongue, diagnosis may be very difficult if the local symptoms have not become sufficiently advanced. At a later stage when swelling of the tongue is extreme, few conditions can be confused or require elimination in differential diagnosis. Palpation of the floor of the mouth discloses no induration here which is always present in true Ludwig's angina. Swelling of the cervical and salivary glands appears secondary to the obvious primary lesion in the substance of the tongue. Fluctuation is often very difficult to elicit because of the induration of the thick, lingual mucosa. Although the entire tongue appears diffusely involved, careful inspection will usually show one side to be slightly larger than the other, and a suggestive area of softening is characteristically present along the lateral side of the tongue in this area. Aspiration, with or without local anesthesia, confirms the presence of pus and establishes the correct diagnosis.

### TREATMENT

The treatment of a lingual abscess is adequate surgical drainage as soon as a collection of pus can be demonstrated. Since these abscesses frequently contain an ounce or more of purulent material, and respiratory embarrassment is a common associated feature, care should be used in the selection of the anesthetic agent. Syme<sup>15</sup> and Prenn<sup>14</sup> have suggested the use of general anesthesia, preferably with the patient in the sitting position, but in more recent years, all surgeons have favored topical anesthesia or novocain infiltration at the site of the incision. Mahoney<sup>5</sup> drained both his patients with the electric

cautery without anesthesia, and reported only moderate discomfort of a transient type. Our own preference is for novocain infiltration and this method was very satisfactory in the case here reported. Every effort should be made to avoid the major vessels of the tongue since their injury results in a brisk and alarming hemorrhage, usually requiring suture ligation. Relief following drainage of the abscess is almost immediate and quite as dramatic as that seen following incision of a retropharyngeal collection of pus. The most distressing symptoms of pain, respiratory embarrassment and inability to swallow rapidly disappear with the relief of tension. Every effort should be made to facilitate free drainage of the abscess cavity by means of frequent warm irrigations and a liberal use of antiseptic mouth wash. Drains or packing of the cavity are not necessary if an adequate incision has been made since the action of the lingual muscles tends to expel the contents of the abscess and obliterate the cavity.

Sulfonamide therapy is a useful adjunct especially in those patients evidencing a marked systemic reaction. Sulfathiazole in adequate dosage is the drug of choice because of its high index of tolerance and the frequency with which the staphylococcus is the offending organism.

In those rare cases of acute parenchymatous glossitis without abscess formation, multiple aspiration is indicated not only to exclude the presence of pus but for the therapeutic benefit resulting from this procedure. Loeb<sup>11</sup> reports one such case which recovered following repeated needle exploration together with the use of ice locally and general supportive measures.

#### MORTALITY

Bennett<sup>1</sup> in reviewing the first 145 cases of abscess of the tongue found a mortality

of 3 per cent. Since this initial report no recorded fatal cases have been found in the literature. This should in no way be interpreted as evidence that these lesions are not extremely dangerous and capable of producing serious complications and death if improperly handled.

#### CONCLUSIONS

A case of acute abscess of the tongue is reported together with a review of the literature on this subject. The principals of diagnosis, treatment and after-care are discussed.

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# RUPTURE OF THE INTESTINE FOLLOWING SEVERE ABDOMINAL MUSCULAR STRAIN\*

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**R**UPTURE of the intestine following severe abdominal straining is not only a rare occurrence but one of extreme surgical interest. Up to date, as far as we know, forty-three cases have been reported in the literature. The association of external trauma to the abdomen, penetrating or otherwise, with internal injury and its subsequent grave prognosis, is a fact accepted by surgeons as not too uncommon. The rare occurrence of the first type of injury, and its significance in industrial medicine, prompts us to report this case.

The pathogenesis has best been described by Haim (as quoted by Wilensky and Kaufman.)<sup>1</sup> "He conceived of the intestinal tract as a single cavity, functionally speaking, of which the intestinal wall and abdominal parietes merely form two concentric layers of the limiting wall. The intra-abdominal pressure is not intraperitoneal, but rather, endo-visceral in its manifestations. Under normal circumstances, it is made to equal atmospheric pressure by the degree of tone of the abdominal musculature. When there is a sudden contraction of the muscles, the bowel is compressed and the endo-visceral pressure is raised. If the visceral wall (in its broad sense, both layers) is weaker at any one point, e.g., at a hernial ring or hiatus, bowel rupture will occur at that point." Such was the case in most of the reports in the literature, namely, a hernia usually of the inguinal variety.

To illustrate further, let us assume that a tire is deficient or weak at one point, let us also assume an inflated tube, within the tire. Because of this deficiency and because

of increased intravisceral (tubal) pressure, this tube is liable to rupture in one of two ways. A sudden increased force in that tire may rupture the tube immediately, or, as the result of repeated traumas, that part of the tube close to the deficiency may slowly break down, become weaker and thinner, and suddenly give way.

The above illustration parallels a similar situation that can occur in the human body. The intestinal wall in a similar situation, due to a sudden, increased intra-abdominal pressure, can perforate at once. However that same wall evaginated into or approximating a weakened area (hernia or hiatus) may later perforate as a result of irreversible necrotic changes taking place in that local segment.

Tschistossersdoff<sup>2</sup> believes that flaccid abdominal layers must be regarded as predisposing factors for the above mentioned type of injury mainly in those cases in which direct trauma is involved. Intestines that are distended with gas are more liable to rupture than when empty. Adhesions and agglutinations of the same also make rupture possible by inhibiting their motility.

## CASE REPORT

On September 23, 1940 at 5:00 P.M., an adult, white, male, a monument maker, aged fifty-five, was brought into the hospital by ambulance, complaining of severe abdominal pain, nausea and vomiting. That morning at 9:30 A.M. shortly after breakfast, he had attempted to lift a heavy stone weighing 200 pounds, when suddenly severe abdominal pain caused him to drop the stone and double up for the moment. The man left his work and went home where he continued to have

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abdominal pain, nausea and vomiting. Late that afternoon the patient was hospitalized.

His past history is significant in that twenty-five years previously he had a laparotomy, and four years later a bilateral herniorrhaphy. There also was a history of a chronic bronchitis.

Examination revealed a middle-aged man, lying in bed with both thighs flexed upon the abdomen and constantly complaining of abdominal pain. Inspection revealed bilateral inguinal surgical scars with a bulging on the left. In addition, a large right rectus scar with a bulging mass in it could be seen. Palpation of this ventral hernia showed the wall to be extremely thin. The abdomen was slightly rigid and tender all over.

The temperature on admission was 99.5°C., the pulse 100, and the blood pressure 120/80. The blood count showed 90 per cent hemoglobin, 4,900,000 red blood cells, 12,000 white blood cells with 89 polymorphonucleurs and 11 per cent lymphocytes. Diagnosis was an incisional hernia with a possible ruptured viscus.

At operation under spinal anesthesia, the abdominal wall over the ventral hernia was found to be extremely thin with adhesive bands binding some of the small intestines to the wall. The peritoneal cavity was filled with intestinal contents. General peritonitis was present. Fibrinous flakes covered the serosa of the gut. About three feet from the ligament of Treitz, a small transverse tear in the jejunum at its antimesenteric border could be seen. In the center of this tear was a perforation through the mucosa, the size of a lentil, from which the intestinal contents welled out. There was no induration characteristic of an ulcer at the site of the tear.

The procedure consisted of aspiration of the intestinal contents and closing of the perforation by two mattress sutures of double No. 00 chronic catgut. The serosa was then brought over with interrupted sutures. Two penrose drains were inserted at the lower angle of the wound. The wound was closed with through-and-through nylon sutures.

The postoperative course was stormy. There was gastric distention, complicated by persistent vomiting, cyanosis brought on by an exacerbation of the patient's bronchitis, dehydration and a rapidly developing anemia. He was treated by gastric lavage, Wangenstein tube, oxygen, intravenous glucose, blood transfusion, etc.

On October 3, ten days later, the sutures were removed in the morning. That same day the patient began to complain of increasing abdominal discomfort and that afternoon he suddenly eviscerated. The patient was taken to the operating room, where inspection of the open wound showed the site of the perforation to be healing. The abdomen was resutured and from then on except for minor difficulties the patient went on to an uneventful recovery.

*Discussion.* Comparison of our case with the forty-three cases collected by Wilensky and Kaufman shows a striking similarity. All their cases were males, the average was forty-eight years of age. Mostly all cases reported had a hernia, usually of the inguinal type. Some had had previous repairs with recurrences. Our case, in addition to a recurrent left inguinal hernia had a large ventral hernia with adhesive bands binding the intestine to the sac wall. The above authors stress the relationship and pathogenesis of an intestinal rupture associated with a small hernial opening in which only one of the walls of the gut is caught in the sac on severe straining. However, we again wish to call to attention Dr. Tschistosserdoff's<sup>2</sup> pertinent observation that adhesions and agglutination of the intestines make rupture possible following severe straining, by inhibiting the motility of the same agglutinated intestines. In their series, the perforation was always on the antimesenteric border of the intestine. Also, these perforations were usually single, varying in size from a lentil to a penny. Lastly, the peritonitis was usually found to be of the fibrinous types.

*Symptomatology.* There is an unusual similarity in the histories of these reported cases and ours.<sup>1</sup> The patient, apparently in good health with the exception of a hernia, which is under control, gives the history of a sudden acute onset of abdominal pain that doubles him up while or following the lifting of some heavy object. Usually, this accident occurs in his work shortly after a meal when the intestines are distended. Nausea, vomiting and even shock may result almost immediately afterward. Soon

after, a let-up in the pain occurs. The patient then quits work and walks home or to a hospital.

Examination of the patient at this time or soon after reveals the temperature to be normal, as is also the pulse. In general, moderate abdominal tenderness and some rigidity are found. There may be more marked tenderness over the hernial site. Here x-ray studies of the abdomen in order to establish the presence of air in the peritoneal cavity, should be of distinct help. If allowed to progress without treatment, signs of general peritonitis and paralytic ileus with attendant symptoms present themselves.

*Prognosis.* The mortality rate is very high; nearly all patients not operated upon die; those operated upon too late also die. Early exploration rather than watchful waiting should be the rule.<sup>3</sup> As reported by Wilensky and Kaufman, if the patient is operated upon within twelve hours, the mortality rate is 40 per cent; within twelve to twenty-four hours, there is a 71 per cent mortality rate; and after twenty-five hours, it is 84 per cent. Dr. Tschistosserdorf's mortality rate is higher: within six hours, 50 per cent; after fourteen hours, 85 per cent died, and after twenty-four hours the mortality rate was 100 per cent.

*Treatment.* This includes immediate operation and repair of the perforation.<sup>1,2,3</sup> If the perforation is large, resection and anastomosis is to be done. Supportive and

prophylactic measures are instituted as the occasion demands.

The importance of this condition in industrial medicine should be stressed in relation to compensability. Kohler<sup>1</sup> reported such a case in which the compensation board ruled that rupture of a normal bowel following muscular effort alone was not possible and that some underlying intestinal disturbance had to exist. However, other European authors have shown otherwise.<sup>1</sup> Wilensky and Kaufman reported such a case in which no previous ulceration of the bowel was present. To this list we add our case which is similar in many respects. Compensation was likewise awarded by the New York State Labor Department.

#### CONCLUSION

A case of intestinal rupture following severe abdominal and muscular strain is reported and added to a list of forty-three other cases, reported and collected from the world's literature by Wilensky and Kaufman.<sup>1</sup>

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# RESUSCITATION OF THE NEWBORN

## CASE REPORT

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A SIMPLE, effective method of infant resuscitation, which requires no complicated apparatus and no special skill, is herein presented.

Artificial respiration was attempted, using the tracheal catheter, but because the throat was so small that the catheter could not be bent to fit it, this method failed. The operator's

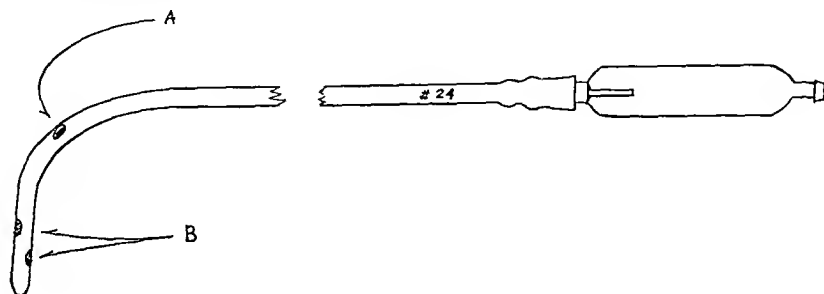


FIG. 1. No. 24 catheter with normal "eyes" closed with gauze and a new opening cut with scissors.

Premature labor occurred in a case of twin pregnancy at six months. The first twin, which was smaller, weighed one pound and eleven

finger was too large to put into the throat to aid in the passage of the catheter.

A No. 20 soft rubber catheter was prepared by plugging the distal opening with gauze and making a new opening about one and one-fourth inches from the tip. A Murphy drip bulb was placed in the opposite end of the catheter.

The obtunded end was pushed into the throat so that it obstructed the upper end of the esophagus. This left the newly cut opening in the mouth. The Murphy drip bulb was held in the obstetrician's mouth and his hands were available for closing the nose and for closing the mouth of the infant around the tube.

The infant's throat having been cleared by aspiration, artificial respiration was started by blowing into the Murphy drip bulb and at the same time closing the infant's mouth and nose. Since the esophagus was obstructed, the air did not go into the stomach, as it does with mouth-to-mouth resuscitation. A satisfactory expansion of the lungs was produced. The fingers closing the mouth and nose were then released to allow for automatic respiration, if it should occur.

The infant's lungs were then deflated by inhaling through the tube, then inflated by blowing through the tube, as before. This

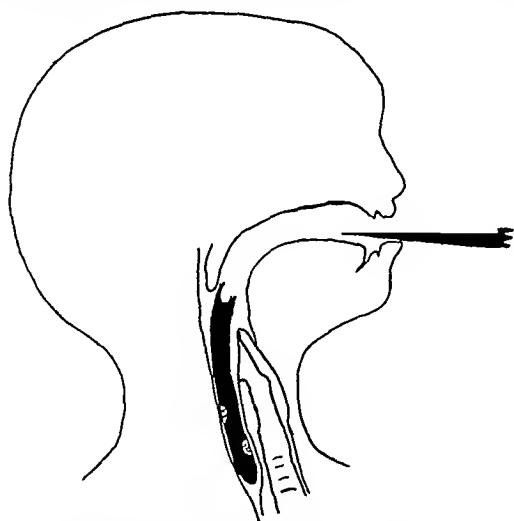


FIG. 2. Diagram shows the end of the catheter in the esophagus and the new opening in the oropharynx.

ounces. It cried spontaneously and breathed satisfactorily. The second twin weighed two pounds, one and three-fourths ounces. The perineal stage was slower because of the larger head. This twin had a satisfactory heart beat but made no respiratory effort at birth.

alternating deflation and inflation caused the submental tissues to contract and expand, and served as an indication that proper pressure changes were being produced. This procedure was repeated with a more or less regular rhythm for one hour. At that time the infant began automatic breathing, which lasted for about ten breaths.

Artificial breathing was kept up for another hour, until automatic breathing was again established. Satisfactory independent respiration was continued from that time until five hours later, when the infant died.

This method, of course, will not work if the larynx is closed by spasm. In this, it resembles the mouth-to-mouth technic. The Murphy drip bulb eliminates the danger of infection travelling from mouth to mouth, in either direction.

The size of the tube will vary with the size of the infant. A full term infant will require a No. 24 or 26 catheter properly to obstruct the esophagus. For a tiny infant, the No. 24 catheter will be too stiff to bend properly in the throat.



IN infants with congenital deficiency of a portion of the diaphragm, attacks of cyanosis and dyspnoea, followed by vomiting, usually direct attention to the existing state of affairs. Hernia through the esophageal hiatus is not to be confused with a congenitally short esophagus in which the stomach may be in the thorax.

From "Intestinal Obstructions" by Owen H. Wangensteen (Charles C. Thomas).

# VAGINAL METASTASIS FROM HYPERNEPHROMA\*

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**M**ETASTASES in the female genital organs from hypernephroma are very rare, and until 1918 only nine fully reported cases of deposits in the vagina were on record. Since then several more have been described and the present case is the sixteenth on record.

In most of the cases the symptoms have been from the vaginal metastasis rather than from the hypernephroma, and, in fact, the diagnosis of the renal tumor has been made from the biopsy of the vaginal mass, as in the present case.

The site of the vaginal metastases is usually on the anterior wall of the vagina, low, and in close relation to the urethra. This aids in the diagnosis but adds to difficulty in the treatment. So characteristic does this site appear that it would seem to be of great value in making the surgeon suspect the nature of the disease. In only one case was the metastasis in the upper part of the vagina. In fifteen of a total of nineteen cases, the primary tumor was in the left kidney, in three in the right, and in two the site is not recorded. There seems to be, therefore, a predominance of cases from growths of the left kidney. This was considered by Gellhorn, Grafenberg and others, to be due to the anatomy of the left ovarian vein which is a tributary of the left renal vein, whereas the right ovarian vein joins the inferior vena cava directly. It has been shown by Kownatzski that the ovarian vein can communicate with the vulval and vaginal veins via an anastomosis between the pampiniform plexus and the obturator vein, and that, therefore, this is a reasonable explanation. In some cases it may be that a primary direct extension

occurs from an intrapelvic metastasis. Additional evidence for the probability of the retrograde venous spread may be obtained from a consideration of the fact that malignant renal tumors are as frequent on one side as the other.

Solitary metastases in hypernephromas are quite uncommon, and in view of the more local method of venous spread in the urogenital system it would appear to be reasonable to regard such cases as these with single vaginal secondary growths as exceptions to the rule. Nephrectomy and excision of the metastasis may thus be a rational procedure.

Treatment of the vaginal condition with radium, or by surgery, affords very little to look forward to, and the prognosis is poor, as few cases survive longer than three years.

## CASE REPORT

Mrs. F. A., age forty-nine, was admitted to the Jewish Hospital of Brooklyn, New York on December 17, 1940. Her complaint was vaginal bleeding of five days' duration, pain in the upper abdomen for three months, fever, anemia of three months, and cough and chest pain for the past six months. The family history was negative. Spontaneous occurrence of menopause had taken place eight years before. A vaginal plastic operation had been done a year and a half previous to admission, and there had been a complaint of loss of appetite and weight since.

On admittance, the patient had a fever of 102.4°F., and the pulse was 104; she was acutely ill. The skin was yellow, and a pallor was apparent. Examination of the lungs revealed lagging at the right base on inspiration, with dullness on percussion, distant breath

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sounds and persistent râles. A friction rub was heard in the right axilla. The heart was slightly enlarged to the left, with a systolic murmur present at all valve areas. Abdominal examination revealed the liver at the level of the umbilicus to be smooth and tender with a sharp edge palpable. The left kidney was felt three fingers below the costal margin, moving with respiration and tender to palpation. There were fulness and tenderness in both lower quadrants.

On vaginal examination, there was moderate active bleeding. A mass 3 by 2 cm. was noted protruding from the vagina arising 2 cm. within the introitus just to the right of the urethra from the vaginal wall. Manipulation of this mass produced considerable bleeding on only slight pressure. A grayish exudate covered part of the mass. Small thrombosed vessels were visible on the surface. There was fair pelvic floor support and a parous introitus. The cervix was lacerated bilaterally but was otherwise normal. The uterus was of normal size, and there was some limitation of motion, due to thickening of the left parametrium. Rectal examination added no further information.

X-ray of the lungs was negative. The cardiac shadow was increased to the left and the aortic knob somewhat pronounced. The electrocardiogram was normal. Blood cultures were sterile.

Excretory urography revealed a normal kidney on the right. The left kidney was considerably enlarged and a little of the dye was found in the upper calyx and some in the pelvis, but there was a hiatus between the upper calyx and pelvis. There was no evidence of metastatic disease in the ribs, spine, pelvis or hips. Upper retrograde study of the kidneys revealed slight elongation of the upper left calyx.

Urinalysis showed a heavy trace of albumin, many triple phosphate crystals, rare granular casts and a specific gravity of 1010. Blood sugar was 127 mg., urea of 9.5 mg. The Kline test was negative. Blood counts revealed an anemia of 53 to 56 per cent hemoglobin, with 3,350,000 to 3,450,000 red blood cells, and a white blood cell count of between 8,300 and 13,900, with a normal differential count.

A diagnosis of carcinoma of the vagina was made, and operation performed for removal of the vaginal tumor. Sutures were placed on each side of the vaginal tumor. The base of the

neoplasm measured 2 by 2 cm. The surrounding tissue was clean and normal in appearance. The tumor was removed by knife and coagulation cautery and the base coagulated. Dilatation and curettage of the uterus was performed. The uterus measured  $2\frac{1}{2}$  inches in depth, and almost no tissue was obtained.

The microscopic pathologic report was as follows: Part of the surface of the tissue is covered by stratified squamous epithelium, with keratinizing superficial layers and blunt rete pegs. Some of the cells show hydropic changes and in places marked acanthosis. In other places, the surface epithelium is denuded and replaced by a meshwork of fibrin with enmeshed polymorphonuclear leucocytes and small round cells. Within the papillae are distended lymphatics and thin-walled blood vessels and an infiltration of small and large mononuclears and polymorphonuclear leucocytes. In the deeper portions are nests of large cells polyhedral in shape and varying in size. Cytoplasmic borders are distinct, cytoplasm clear or foaming and the nuclei hyperchromatic. Capillaries are engorged and there are foci of freshly extravasated blood. Within the stroma is the same type of infiltration. In the deeper portions are occasional nests of polyhedral cells varying in size and shape and in the staining reaction of their nuclei. Some of the cells here are in mitotic division. Some of the cells show intercellular bridges. In places tumor cells are seen within distended lymphatics. Diagnosis: Carcinoma of the vagina, metastatic from a hypernephroma was made.

The patient was discharged from the hospital on December 27, 1940, with her condition unimproved. Her condition continued to grow worse and she died about four months later.

#### SUMMARY

A case of vaginal carcinoma, metastatic from a hypernephroma is presented. Diagnosis of hypernephroma was first made through microscopic examination of the vaginal tumor.

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A SHORTENED vaginal canal resulting from vaginal hysterectomy occurs only in those cases where the rectovaginal septum has been completely destroyed by an enormous sacropubic hernia or where an extremely large enterocele coexists with procidentia.

From "Vaginal Hysterectomy" by James William Kennedy and Archibald Donald Campbell (F. A. Davis Company).

# CARCINOMA OF THE JEJUNUM

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**C**ARCINOMA of the small intestine is of infrequent occurrence though the most common of all small intestine tumors, the order of frequency being, first carcinoma; second, sarcoma; and third, the benign tumors, fibroma, myoma, cyst, etc. There have been fewer than 300 cases of carcinoma reported so far.

*Autopsy Statistics.* Christofferson and Jacobs<sup>1</sup> gathered autopsy statistics from several large hospitals, aggregating 90,892 autopsies, and found carcinoma of the small bowel in fifty-eight. Of these, twenty-six were in the duodenum, eight in the jejunum, twenty-two in the ileum and two undetermined.

*Surgical Statistics.* Medinger<sup>2</sup> in a collected series reported 134 cases of small intestine malignancy, fifty-one occurring in the duodenum, thirty-nine in the jejunum and forty-four in the ileum.

Mayo<sup>3</sup> reported 101 cases of malignancy of the small intestine from the Mayo Clinic, of which twenty-four were in the duodenum, thirty-nine in the jejunum, thirty in the ileum, four multiple and in four the site was not specified. Eighty of these were adenocarcinoma.

Raiford<sup>4</sup> in his very comprehensive article on tumors of the small intestine, reporting on 986 gastrointestinal tumors from Johns Hopkins Hospital, states that of all tumors of the gastrointestinal tract 8.9 per cent were of the small intestine, whereas of the malignant tumors of the gastrointestinal tract 4.9 per cent were of the small gut, but listed only four cases of carcinomas of the jejunum.

During the ten-year period from 1921 to 1930 inclusive, there were observed at the Mayo Clinic: 2,513 cases of carcinoma of

the stomach, 2,767 cases of carcinoma of the large intestine, and twenty-five cases of carcinoma of the small intestine, eight of which were of the jejunum. Forty-seven hundredth per cent of all gastrointestinal carcinomas involved the small intestine but only 0.15 per cent involved the jejunum (Mayo and Nettrour<sup>5</sup>).

In addition to our own two cases, there occurred at the Cedars of Lebanon Hospital from May, 1930, to September, 1941: one case of carcinoma of the jejunum and one case of sarcoma of the jejunum. During this same period there were 650 cases of carcinoma of the stomach and large intestine distributed as follows: stomach 224, colon 234, rectum 192.

The age of patients harboring malignancy of the small intestine corresponds with the age of patients suffering malignancy in other parts of the body.

Mayo and Nettrour<sup>5</sup> give the operative mortality in cancer of the jejunum as 20 per cent and the average duration of life following operation as 17.6 months. The usual high grade of malignancy of cancer of the small bowel and the abundant lymphatic drainage of this region, with the consequent rapid metastases, readily explain the high mortality rate.

There are three forms of carcinoma of the jejunum: The most common type of lesion is the annular constricting adenocarcinoma; next in order of frequency is the infiltrating ulcerative type, and finally the polypoid type with intussusception as a not rare complication.

The usual site of jejunal cancer is in the proximal portion. Carter<sup>6</sup> in an analysis of 30 cases found 72 per cent occurring within the first twelve inches of the jejunum.

## SYMPTOMS

The symptoms of cancer of the small intestine are: indigestion, eructations, meteorism, feeling of fullness, nausea, vomiting, epigastric distress, tenderness, pain dull and aching in character but later cramp-like, constipation, anorexia, asthenia, fatigability, loss of weight, melena rarely, occult blood in stools, tumor may rarely be palpable and anemia. Perforation with peritonitis may occur as a complication.

Obviously many of these symptoms are common to various other conditions. Those most characteristic and most likely to lead to a correct diagnosis are: epigastric distress, vomiting, asthenia, loss of weight, anemia and occult blood in the stools. The finding of occult blood in the stools is a very significant sign if the stomach and large intestine are exculpated. Short episodes of intestinal obstruction occur, increasing in frequency and severity as the obstruction becomes more pronounced. Some cases have been erroneously diagnosed as pernicious anemia. Having in mind the possibility of small intestine carcinoma and performing careful stool examination for occult blood should avoid this error.

The methods of determining the presence of small bowel tumor are few. X-ray would appear to be the most valuable. However, as the contents of the small gut are liquid, marked obstruction must exist before the x-ray films will disclose the condition. Any marked delay in the passage of barium through the small intestine is very suggestive of mechanical obstruction and should arouse suspicion. By taking x-ray pictures at frequent intervals, one may be able to detect obstruction or filling defects that would be missed by the usual manner of taking gastrointestinal pictures. Weber and Kirklin<sup>7</sup> wisely state, "It is to be emphasized that roentgenoscopic examination is of greatest value and that no number of roentgenograms can replace it."

## CASE REPORTS

CASE 1. The patient, a female, aged forty-eight, entered the hospital October 24, 1932,

complaining of progressive weakness, loss of weight, anorexia, vomiting, pain and burning sensation in epigastrium, and fainting spells during the last year. General physical examination showed emaciation; no masses were felt in the abdomen. Anemia was marked; hemoglobin 28 per cent, erythrocytes 2,150,000, leucocytes 4,700, neutrophils 67 per cent. The Wassermann test was negative. Gastric analysis disclosed an absence of hydrochloric acid. Proctoscopic examination evidenced no abnormality for ten inches. Repeated tests for occult blood in the stools were all positive. A barium enema revealed no abnormality of the colon. Following the administration of barium by mouth there appeared a marked six-hour residue in the stomach and duodenum. Several transfusions of whole blood brought the hemoglobin up to 62 per cent and 3,490,000 erythrocytes. Preoperative diagnosis was tumor of the small intestine, probably malignant.

Operation was performed on November 28th. The abdomen was opened through a right upper paramedian incision, retracting the rectus muscle laterally. Nothing abnormal was found in the stomach or duodenum. Ten inches from the origin of the jejunum there was found a hard nodular tumor about an inch in diameter. There were several large glands in the adjacent mesentery and a few small palpable glands along the great vessels. A V-shaped resection of about ten inches of jejunum with its mesentery was performed followed by an end-to-end anastomosis. The patient left the hospital with the wound well healed and no complaints on December 11th.

*Pathologist's Report:* "The specimen is a 29 cm. segment of jejunum. The surface of the tumor presents a depressed, partly annular scar extending approximately one half its circumference. The serosa otherwise is smooth and gray. The scarred area is firm and on opening there is seen an annular, ulcerating tumor extending over three quarters of the circumference. It is about 3 cm. long and elevated to about 0.6 cm. The edges are nodular, wavy, and raised. The base is granular and partly necrotic.

"Microscopic: Section through tumor shows an adenocarcinoma which infiltrates beyond the muscularis mucosae. The glandular formations are fairly large and of irregular outline, and have no limited membranes. Some are lined with a single layer of tall columnar or cylindrical cells. In others there are two layers

with loss of polarity and the cells are shorter. Mitotic figures are infrequent. Along the surface there is a heavy polynuclear infiltration but in the deeper portion there are many eosinophiles and lymphocytes. The structure of the tumor does not suggest argentaffin tumor. The lymph glands in the mesentery show only hyperplasia; no evidence of metastases.

"Diagnosis: Adenocarcinoma of the jejunum."

On May 3, 1939, the patient reentered the hospital, complaining of bloody diarrhea of six months' duration. An abdominoperineal resection for adenocarcinoma of the rectum was performed on May 12th. She left the hospital on June 24th. She was last seen on October 22, 1941, at which time she was of normal weight, comfortable and seemed well.

CASE II. The patient, a female, aged sixty-two, entered the hospital with general peritonitis and died twenty-seven hours later. Autopsy showed general peritonitis due to

carcinoma of the jejunum with perforation about eighteen inches from the ligament of Treitz.

#### SUMMARY

Two cases of carcinoma of the jejunum are reported. To indicate the rarity of the condition, autopsy and surgical statistics are given. The symptoms most likely to lead to a correct diagnosis are stressed.

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# UNUSUAL GUNSHOT WOUND OF ABDOMEN

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IT has long been recognized that a bullet, fired from a gun, may follow a bizarre course through the human body. One, therefore, can not be sure upon examining the body and finding a wound of entrance and a wound of exit, that the bullet passed directly between these two points.

DaCosta states "that a revolver bullet is liable to deform in the tissues, is often deflected from bone or tendon and is very apt to lodge. In some cases a bullet has entered near the front of the body and passed around the wall of the chest until it has almost reached its point of entrance—constituting what is known as a contour wound. A bullet may strike the frontal region of the head, pass around under the scalp, lodge in or emerge from the occipital region."

With the whole world involved in war, with thousands of men being killed and wounded daily, surgeons will see various kinds of unusual injuries. However, in times of peace and in a civilized country, one should not encounter very many unusual gunshot wounds.

I wish to report an unusual gunshot case, of interest because of the course the bullet followed in the body, the treatment used and the end result:

## CASE REPORT

A colored man, age twenty-three, was admitted July 18, 1939, at 4:15 A.M. to the surgical service of Dr. Edward B. Hodge, Presbyterian Hospital, Philadelphia, Pennsylvania with a bullet wound of entrance on the medial anterior surface of the left thigh about eight inches above the knee. On admission he was in shock, blood pressure was 80/30, pulse rapid and thready and his skin was cold and clammy. He complained of severe pain in his abdomen. He was treated for shock and given 10 per cent glucose intravenously. Because of the absence

of a wound of exit and because of pain in the abdomen with tenderness and rigidity, a flat plate x-ray of the abdomen was taken which revealed a bullet lying in the abdomen at the level of the umbilicus, and an x-ray of the leg was negative even for any bony injury. His blood count showed hemoglobin 63 per cent, red blood cells 3,800,000, white blood cells 8,900, blood sugar 116, blood urea nitrogen 22, chlorides 630.

He responded to the treatment for shock and at 7 A.M., under general anesthesia, I opened the abdomen through a midline incision. The abdomen was full of blood and the pelvis was full of blood and feces. The bullet was found lying free in the abdomen and was removed. There were four perforations in the ileum and one large perforation of the sigmoid which were repaired. In order to examine the rectum and posterior wall of the bladder, it was necessary to take the gloved hand and remove from the pelvis several handfulls of feces. When it was cleaned out, a hole in the rectum about four inches long was found which accounted for the large amount of feces spilled out. The hole was properly repaired. On examining the bladder a perforation on the posterior wall near the rectum was found and also carefully repaired. Three rubber covered Penrose drains were inserted and the peritoneum closed. Skin sutures were continued down to the peritoneum but were not tied. The ends of the sutures were tied together to keep them from coming out, with the idea in mind of tying them one by one later. The abdominal wound was left open and packed with a dressing saturated with tincture of merthiolate. An indwelling catheter was inserted and the patient returned to the ward in a fairly good condition.

The head of the bed was elevated eight inches and the patient placed on his abdomen and kept there for forty-eight hours. He was given fluids intravenously, 1 ampule of prostigmin every four hours, 1 Gm. of sulfanilamide every four hours, and morphia for pain. Three days later, July 21, 1939, his temperature was 102.4°F., pulse 140 and the abdomen was

somewhat distended. A Wangensteen tube was inserted, the patient given 475 cc. of fresh citrated blood and other general supportive measures were administered. On July 24th his hemoglobin was 39 per cent, red blood cells 3,280,000, white blood cells 14,200, blood sugar 122, carbon dioxide 45, blood urea nitrogen 29, chlorides 580. He was given 290 cc. of citrated blood on July 24th and 525 cc. on July 26th.

His general condition began to improve, his temperature and pulse began to drop and by August 21st, his temperature was 100°F. and pulse 100. The indwelling catheter had been removed and he was urinating normally. There was still a foul discharge from the incision. On August 8th his hemoglobin was 48 per cent, red blood cells 3,570,000, and white blood cells 9,100, and on the tenth he was given another transfusion of 425 cc. of citrated blood. From August 2nd to August 19th his temperature varied from 99° to 100°F. and pulse from 85 to 100. The patient was on a house diet and on August 19th he was allowed out of bed and from then on he continued to improve until September 12th, the day before he was to be discharged, when he began to complain of pain in his left testicle. The testicle became swollen and tender and a consultation from the genitourinary department was secured and he was transferred to their service. On September 20th, a left orchidectomy was performed by Dr. F. G. Harrison of the genitourinary service.

His convalescence from this point on was slow but satisfactory and he was discharged on

October 12th to return to the surgical dispensary for dressings and was discharged from there on November 20th with all wounds healed. He has been seen in the follow-up clinic every six months since and on the last visit there was evidence of a small, incisional hernia. He feels perfectly fine, has a good appetite, weighs more than he ever weighed, his bowels move regularly and he has no difficulty in urinating.

#### CONCLUSIONS

1. An unusual gunshot case is reported with wound of entrance in middle one-third of thigh and causing perforations of bladder, rectum, sigmoid and ileum.
2. With no wound of exit, the fluoroscope and x-ray should be used to locate the bullet and to help in determining organs and tissues probably injured.
3. Postural drainage and open abdominal wound treatment, which allowed free drainage and prevented extensive abdominal wall infection, was a factor in saving his life.
4. While the course was stormy, the patient made a very satisfactory recovery.

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# AVULSION OF THE SCALP

## CASE REPORT

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ONE of the most common injuries seen in hospital and office practice is laceration of the scalp. When one considers the large number of scalp injuries it is interesting to note that few of these involve destruction of the pericranium or periosteum of the skull. A review of the literature reveals many cases of extensive avulsion of the scalp, but without destruction of the pericranium. A large number of these reported cases were women factory workers who caught their hair in moving machinery. Coleman<sup>1</sup> reported two cases with extensive scalp injury including destruction of the pericranium as a result of severe electrical burns.

Because of the infrequency of scalp wounds with loss of the pericranium we desire to present such a case from the Surgical Service of the Camp Croft Station Hospital:

### CASE REPORT

F. B. Y., a white male, age thirty, was admitted to the hospital on July 26, 1941, following an automobile accident in which the patient incurred extensive avulsion of the scalp, caused by the rear wheel of the automobile striking the patient's head.

On examination the patient was found to have an avulsion wound of the scalp involving the right parietal and temporal regions, about five to six inches in diameter, extending through the galea aponeurotica and upper part of the temporalis muscle and the pericranium down to the skull with a considerable loss of tissue including the pericranium.

Extensive débridement and cleansing with green soap and water under local anesthesia were carried out. A large amount of dirt and small cinders was removed from the wound. The open defect in the scalp was packed with vaseline gauze. The vaseline pack was changed

daily and the wound irrigated with azochloramide in triacetin 1 to 500.

On August 16, 1941, twenty-one days following date of admission, numerous small holes were drilled through the outer table of the skull. These holes were drilled with an ordinary dentist's drill  $\frac{1}{16}$  inch in diameter. No pain was experienced by the patient during the procedure. The openings were extended in depth until blood began to ooze from the bottom of the holes. Holes were made about  $\frac{1}{8}$  inch apart and in sufficient number to cover the area of bare bone. The wound was irrigated daily and on August 28, 1941, clean, granulation tissue was seen growing from the tiny openings in the bone. On October 6, 1941, when granulation tissue had filled in the defect pinch grafts were taken from the left thigh, placed in the defect and a dry dressing was applied. On October 20, 1941, additional pinch grafts were placed on the wound. The patient was discharged on December 6, 1941, in excellent condition with good cosmetic results.

### GENERAL COMMENT

The problem one faces in the type of wound under consideration, after adequate débridement and elimination of infection have been carried out, is the production of adequate granulation tissue to fill in the defect. Granulation tissue will not grow over a large area of bare bone because of the absence of the periosteum with its blood supply. The earliest report on this subject, according to Haggard,<sup>2</sup> was by Vance in 1777. Faced with such a case Vance bored numerous holes in the skull "until a red fluid appeared" in the opening. After a short time "Proud flesh appeared to rise from the holes." Treatment today is essentially that of Vance's technic. Coleman<sup>1</sup> in his two cases removed the entire outer table of the skull in the involved area and obtained excellent growth of granula-

tions which he covered by Thiersch grafts in one case. Drilling of numerous small holes through the outer table of the skull seems to be the treatment of choice according to most works on surgical technic, and has the advantage of being a simple procedure which can be performed with a borrowed dentist's drill and carried out in the office. No anesthesia is necessary as drilling through the bare outer table of the skull produces no pain.

The anatomy of the scalp accounts for the infrequency of destruction of the pericranium in the presence of extensive avulsion wounds. The scalp is made up of several layers: the skin, which is very thick; the superficial fascia; the epicranium which is made up of the frontalis and occipitalis muscles united by a tendinous aponeurosis which covers the greater part of the cranium. This aponeurosis, the galea aponeurotica, is attached to the muscles mentioned, anteriorly and posteriorly, and at the sides gives origin to the auricularis anterior and superior where it loses its aponeurotic character and is continued over the temporal fascia as a layer of areolar tissue. It is closely connected to the skin by the superficial fascia. It is attached to the pericranium by loose cellular tissue which allows the galea aponeurotica considerable motion carrying the skin with it. Thus it is evident why even severe wounds of the scalp will tear through the galea but will not involve the pericranium. Due to its

loose attachment to the pericranium the galea will give way with the skin and superficial fascia, without damage to the periosteum which is closely adherent to the skull.

In the event of a complete avulsion of the scalp through the pericranium the only blood supply which is available to remedy the condition is in the diploic veins. These veins occupy channels in the spongy bone between the outer and inner tables of the skull. The diploic veins are large and exhibit at irregular intervals pouch-like dilatations. The walls of these veins are very thin and are composed of endothelium resting upon a layer of elastic tissue. These vessels communicate with the meningeal vessels, and with the veins of the pericranium through tiny openings in the outer table of the skull. The connecting veins to the outside are known as emissary veins.

#### SUMMARY

1. A case of avulsion of the scalp is presented.
2. Adequate granulation tissue is obtained by boring multiple holes in the outer table of the skull in avulsion of the scalp with destruction of the pericranium.

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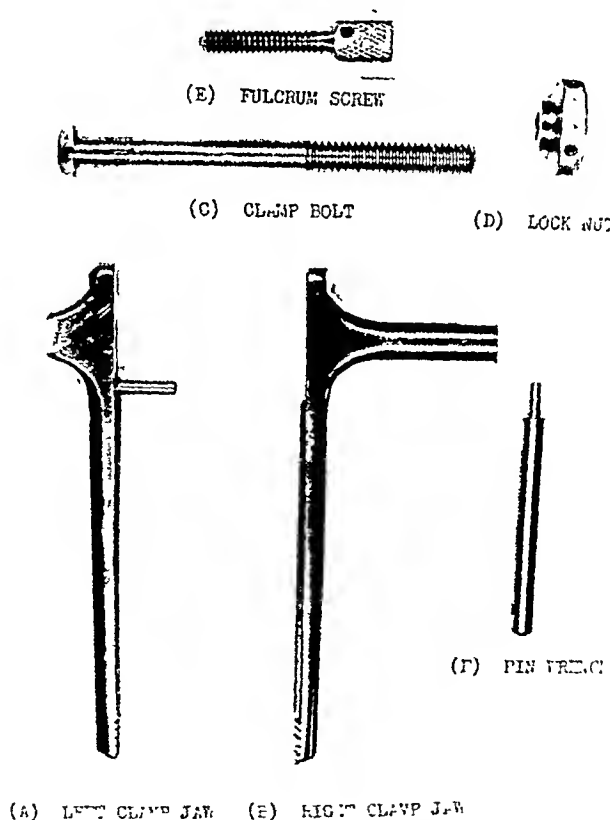
# New Instruments

## INSTRUMENT FOR CRUSHING THE SPUR OF A COLOSTOMY

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ON the gastrointestinal surgical service of the Jewish Hospital, Brooklyn, New York, all left colon colostomy into a single barrel colostomy. To crush the spur, we have used many types of instruments, including simple



(A) LEFT CLAMP JAW (B) RIGHT CLAMP JAW

FIG. 1. Illustration showing the various parts of the instrument for crushing the spur of a colostomy.

resections are done almost exclusively with an exteriorization procedure and delayed intestinal union.

One of the steps in management of such cases is the crushing of the spur for the purpose of converting the double barrel

hemostats, Ochsner clamps and specially devised enterotribes. This is, of course, an admission that there is no one instrument which is satisfactory in all cases. The difficulties encountered included some of the following: some instruments are too large,

heavy and cumbersome; some clamps protrude too far above the abdomen; some clamps do not come apart, hence the blades have to be applied as one. Most enterotribes do have separate jaws and the few parts can be reassembled. However, when each jaw is placed in its respective lumen of bowel, the length of the guide pins on the clamps, which permit apposition, makes reassembling difficult and thus the bowel is traumatized.

Our greatest objection to most clamps is that once the clamp is applied and pressure exerted on the septum of tissue, the tips of the clamp have a tendency to rotate; they spread apart rather than crush the tissue evenly. We find that when the clamp is removed there is a stump or stub of septum left behind which requires reapplication of the clamp.

During the past year a left colectomy was performed upon Mr. Robert Ringel of Brooklyn. He saw our difficulties and was interested in our problem. He designed and had constructed the proposed clamp which in our hands has been most satisfactory.

A consideration of the mechanics of the clamp may be advisable. All clamps are essentially two rigid bars whose faces are drawn against tissue. The bars act similarly to levers, in that their fulcrum is somewhere along the length of tissue being crushed, while the force is remotely applied at some external point, such as the screw drawing the two bars together. Manifestly, the bars rotate about this fulcrum point in the tissue, causing the tips to diverge. Of course, the longer the bars and the more remote the screw drawing them together, the greater the rotation at the tip of the clamps. In this new instrument, the tendency to rotate is counteracted by providing another positive, fixed external fulcrum, adjustable for any desired angle of rotation by means of the fulcrum screw about which it must rotate. This screw threads into one part of the clamp, and its point fits into a drilled socket in the other half, thus tending to force the external ends of the clamp apart. Such a procedure causes the clamp

tips to rotate toward the tissue, especially in the area usually resulting in a stub or a stump.

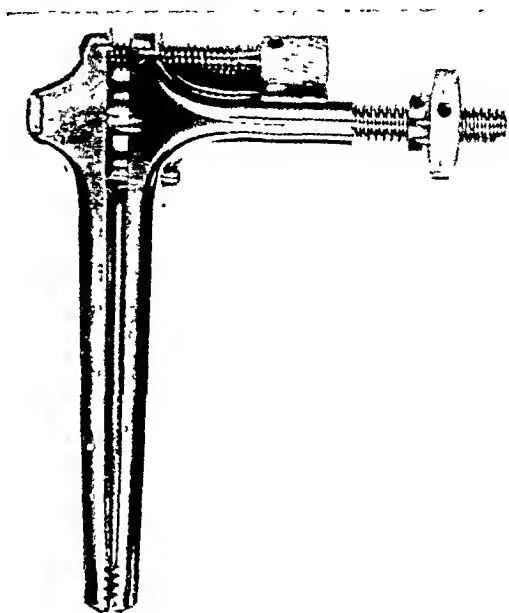


FIG. 2. Illustration showing the instrument assembled.

This instrument\* (Fig. 1) consists of (A) a left clamp jaw, 4 inches long over all, bearing a guide pin on its crushing face; (B) a clamp jaw bears integral with it and at right angles a cylinder to receive the bolt; (C) a clamp bolt used in conjunction with the lock nut; (D) a lock nut, and (E) a pin wrench to facilitate tightening and loosening of the lock nut and fulcrum screw (E).

In crushing the septum the following has been our procedure: The left jaw clamp is inserted into the lower loop of the double barrel colostomy and the right jaw is inserted into the upper lumen to the depth desired. The two jaws are brought together with the guide pin. The clamp bolt is then inserted so that its head is held snugly within the recess of the left jaw and the lock nut is threaded on holding the hand tightly so that the clamp jaws grip the septum firmly. The fulcrum screw is tightened by means of the pin wrench, giving the clamp tips the desired amount of advance. The

\* The instrument shown assembled in Figure 2 is manufactured by Edward Week & Co., Brooklyn, New York.

pin wrench is applied to the lock nut and tightened until it jams against the cylinder barrel of the right jaw. Both jaws jammed in place will prevent any slipping from the position and pressure selected. The usual care must be exercised so as not to apply excessive pressure with its attendant ills.

The next crushing adjustment is made by releasing the fulcrum screw, about one-half turn with the pin wrench and then immediately taking up the play until the desired additional crushing has been effected for the second stage; jam the fulcrum screw and lock nut as above. The subse-

quent stages are but repetitions of the foregoing.

The advantages of this instrument may be summarized as follows: (1) It is light weight; (2) it protrudes only one inch above the abdomen; (3) its application is easy for the patient, for its jaws are completely separate and the few parts are reassembled without difficulty; (4) daily adjustments during the crushing process are accomplished with ease; and (5) crushing of the septum is even throughout the entire length of the clamp surface, leaving no stump to be eliminated later.



FOR obstruction of the small intestine, occasioned by neoplasms, enterostomy, exteriorization and entero-anastomosis are alternative operative procedures. If the factor of distension has been dealt with satisfactorily by suction applied to an indwelling duodenal tube, primary resection is probably the procedure of choice.

From "Intestinal Obstructions" by Owen H. Wangensteen (Charles C. Thomas).

# SIMPLIFIED APPARATUS FOR SURGICAL COLOR PHOTOGRAPHY

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THE apparatus to be described was constructed with the objective of facilitating the photography of findings during surgical procedures. This was done

must be portable, (2) the procedure of taking the picture simplified, and (3) the danger of contamination of the field minimized.

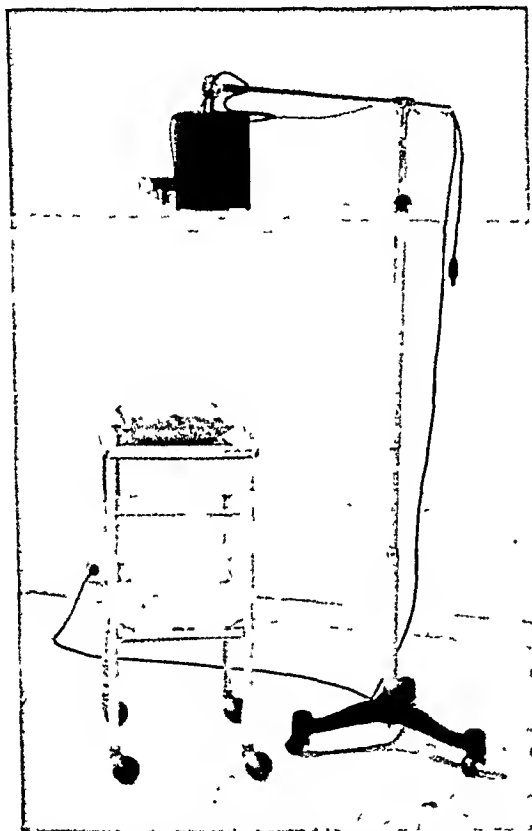


FIG. 1. Complete surgical photographic unit in place over a table ready to photograph a gross specimen. Camera protrudes at left of light box. Controls are at right.

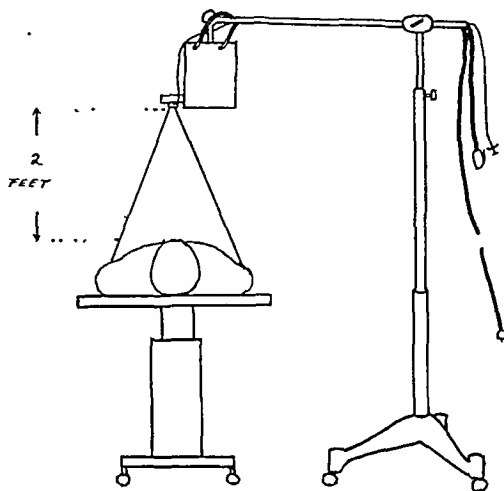


FIG. 2. Unit in place over patient on operating table. Elevated to two feet above skin surface. This arrangement is suitable for photographing organs brought up into wound, within two and one-half inches of skin. (Depth of focus at 2 feet is 5 inches; 2 feet  $\pm$  2½ inches.)

## APPARATUS

The unit consists of the following parts: (1) A 35 mm. Argus color camera, with diaphragm set at  $f_4$ , distance at two feet, and shutter at  $\frac{1}{25}$  sec., is mounted on the front of the light box. (2) The light box, constructed of sheet metal, is 8 by 10 by 13 inches and has a screw and bracket attachment on front for the camera. The lower surface is covered with a plate of glass which separates the two Wabash reflector superfluor bulbs within from the operative site. Vanes on the upper surface provide ventilation. (3) The unit is hinged to the cross bar of a light standard. It can be adjusted by rotating the cross bar, elongating the cross bar, rotating the unit at the

in the belief that simplification of the equipment to the point where it could be operated entirely by the constantly changing and photographically inexperienced personnel of the operating room would encourage the recording in color of interesting surgical findings. This is particularly desirable in a teaching hospital.

To accomplish this several requirements must be met; (1) the complete apparatus

end of this bar and by elevating the entire upper portion of the standard. (4) The controls for the unit consist of a shutter release and spring light switch, each on a

light source at the same distance, the light reflected from the various operative fields and gross specimens does not vary enough to alter the exposure appreciably.

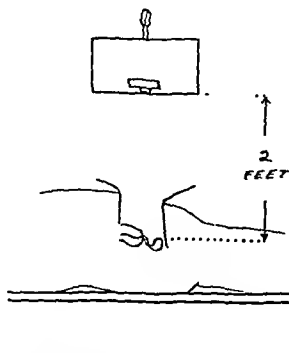


FIG. 3.

FIG. 3. Illustrating the allowance which must be made when taking pictures of areas more than two and one-half inches below the skin surface.

FIG. 4. Unit angulated for photography of vaginal and rectal surgery.



FIG. 5.

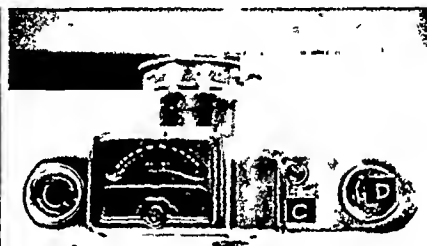


FIG. 6

FIG. 5. Remote controls for lights (A) and shutter (B).

FIG. 6. Controls for advancing film. Immediately after each picture press button (c) and turn knob (D) one-quarter turn. Then release pressure on button and continue turning knob until resistance is felt. The film is then ready for the next exposure.

five-foot extension. The lights are on only while pressure is applied to the switch so that accidental overheating of the tissues is impossible.

#### METHOD

The procedures necessary for taking a picture with this apparatus consist of: (1) Adjustment of the camera to two feet from the area to be photographed (Figs. 2, 3 and 4); (2) centering over this area (the field at this distance is 10 by 15 inches); (3) pressing the light switch and then the shutter release (Fig. 5); and (4) advancing the film in preparation for the next exposure. (Fig. 6.)

It will be noted that no exposure meter readings are taken and no adjustments are made on the camera. It has been found that under these constant conditions, the same

#### SUMMARY

An apparatus for surgical color photography is described which combines small size, portability, simplicity and rapidity of operation. No photographic knowledge is required to use it and the results are uniformly good.

The use of this unit is so convenient that the ideal of a photographic record in natural color of every operation and gross specimen is attainable at negligible cost\* and with inexpensive but efficient equipment.

\* Cost. The total cost of the unit was about \$85.00. A projector suitable for medium sized audiences costs \$33.50. The final cost of each color slide, developed and ready for projection, is 13 cents, less than a black and white enlargement. Natural color prints or black and white enlargements can also be made directly from these transparencies when needed for publication or case histories.

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## Editorial

### THE PRESENT STATUS OF VESICOVAGINAL FISTULA

THERE is probably no condition which has caused more discomfort and suffering to womankind than vesicovaginal fistula. It is, therefore, surprising to note, as one studies the history of this malady, that procedures for its relief came at such a relatively late date. From 1845 to 1849, J. Marion Sims had under his almost constant care those three heroic young Negro girls, Lucy, Betty and Anarcha. Anarcha's fistula was closed in May, 1849, at the thirtieth operation, and from the technic and result of her case were laid down the surgical principles for the closure of bladder fistulas.

Originally, most vesicovaginal fistulas were due to the trauma of labor, resulting from pressure necrosis and sloughing rather than from forceps' cuts or lacerations of the tissues. Although in the majority of these cases, it is true, the labor was terminated instrumentally, the pressure necrosis had occurred before the application of the forceps; in other words, it was the withholding of the forceps rather than their use that was responsible for the disorder. Obstetrical fistulas, with the exception of those that were adherent to one or the other pubic ramus and those in which there was a great loss of tissue, were within the realm of moderately difficult exposure and closure. The original method by which these bladder fistulas were closed depended on three factors: proper distention and exploration of the vagina, a suture which

would not excite inflammation or ulceration, and a method of keeping the bladder empty during the process of healing. With the constant improvement in obstetrics which has taken place during the last half century, vesicovaginal fistulas have become relatively rare.

Surgical fistulas, on the other hand, have increased in number with the advent of surgical asepsis and the constantly increasing number of operations on the female pelvic organs. They are produced by direct injury at the time of operation, especially in operations for cystocele and consequent to hysterectomy, abdominal or vaginal. On account of their location, frequently in a scarred vaginal vault high in the pelvis, they are much more difficult to expose than are obstetrical fistulas, and their closure very often tasks the ingenuity of the operator to the utmost. When a fistula is due to direct operative injury, urinary leakage will occur immediately after operation; when it is due to necrosis and sloughing, leakage will not be observed for a few days.

In addition to obstetrical and surgical fistulas, syphilis, tuberculosis and carcinoma, by erosion and ulceration, may produce an opening between the bladder and the vagina; while constant pressure of foreign bodies, a pessary for example, may be responsible for a rare case.

While a few small fistulas close spontaneously, the treatment of vesicovaginal fistula

is surgical. Preoperative preparation is of utmost importance, and the operation should not be performed until the tissues are in satisfactory condition to hold the sutures.

The suture material deserves some mention. The first bladder fistula was closed by means of silver wire sutures, probably because metallic sutures were unlikely to cause inflammation and tumefaction in the tissues; but silver wire has certain disadvantages: it has a low tensile strength, it cannot be tied, it must be fixed by twisting, and it may produce a disfiguring argyria. Recently, a new noble metal, rustless alloy steel wire, has come into use. It is soft, strong and nonirritating, and has overcome all the disadvantages of silver wire. For this reason it has replaced the latter in the hands of many who believe that metallic sutures have a distinct advantage in the surgical management of vesicovaginal fistulas.

The use of catgut in human tissues causes swelling and exudation of serum and leucocytes, which in three or four days result in the formation of an adjacent necrosis, and by the end of a week in a distinct greenish layer around the catgut, thereby delaying healing until the irritating foreign body and necrotic tissues are removed or replaced. The foregoing shows why fistulas closed with catgut recurred, and were subsequently successfully closed by means of metallic sutures.

A method which has proved successful consists of closing the bladder opening with very fine catgut sutures, skipping the bladder mucosa and closing the vagina with alloy or silver wire sutures. It is important not to resect the edges of the anterior vaginal wall before approximating them, so that in the case of a recurrence there will still be enough anterior vaginal wall with which to work.

Because of the complexity of vesicovaginal fistulas, numerous methods of closure have had to be devised. These may be summarized as follows:

1. The vaginal procedure, including several varieties of technic.\*
  - A. Paring the edges and closing in one layer with silver wire or alloy wire sutures.
  - B. Circumcising the fistulous opening, turning the cuff into the bladder, closing the fistula by approximating the bladder musculature over the cuff without penetrating the bladder mucosa, and closing the vaginal wall separately. The vaginal wall is satisfactorily closed by means of metallic sutures placed perpendicular to the line of bladder suture, thus staggering the suture lines.
  - C. Mobilization of the bladder and closure of the bladder and vagina in separate layers.
  - D. Using the cervix and body of the uterus to close the opening.
  - E. Suturing pedicled flaps from the vagina and vulva to bridge over the defect.
  - F. Using the gracilis muscle as a pedicle flap (Garlock technic).
  - G. Colpocleisis.
2. The intravesical procedure through a suprapubic incision, best illustrated by the method of Hugh H. Young.
3. The suprapubic extraperitoneal procedure through a Pfannenstiel incision.
4. The intraperitoneal procedure through an abdominal incision, Lequeu technic). This is especially useful in high fistulas, following panhysterectomy, where they are inaccessible vaginally.
5. Implantation of the ureters in the sigmoid (Coffey technic).

The postoperative care is all important, and should be carried out by the operator himself, and not left to less experienced young assistants. Constant bladder drainage is usually instituted, except in the case of transplantation of the ureters. The

\* The Schuchardt incision has proved of great value in exposing the fistula.

Foley self retaining catheter has all the advantages of a plain catheter and none of the disadvantages of the bulbous ones, in which the bulb may press upon the suture line. Irrigation of the bladder with warm boric acid solution should be carried out as indicated, but no strong antiseptics should be left in the bladder. Sulfadiazine may be employed in small doses as a urinary antiseptic while the catheter is in place. Constant bladder drainage is usually maintained for ten days, longer if necessary, and keeping the patient on her

abdomen during part or all the convalescence is helpful in most instances.

If metallic sutures are used, they should be removed at the end of a month, preferably under anesthesia. Finally, careful pre-operative preparation, meticulous technic, attention to small details and postoperative care at the hands of the operator himself may reward the surgeon with the comfort which he has given his patient in overcoming this distressing malady.

LOUIS E. PHANEUF, M.D.



WE know of no results that are more brilliant than vaginal hysterectomy clamp method for fundal malignancy. Fundal malignancy comes later in life, is slow to metastasize and therefore gives the best prognosis of any location of uterine malignancy.

From—"Vaginal Hysterectomy" by James William Kennedy and Archibald Donald Campbell (F. A. Davis Company).

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# Original Articles

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## CONDITIONS OF THE BILIARY TRACT REQUIRING URGENT SURGERY\*

FRANK GLENN, M.D.

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NEW YORK, NEW YORK

THERE are no methods or plans of treatment employed by the medical profession that cannot be improved upon. Our knowledge at the present time does not include a complete understanding of the processes involved in tissue damage and repair. Until it does, our best criteria for guidance are to be found in the studies of results, not from a single method or plan, but from many, adding new ones as newly found facts justify them. The treatment of diseases of the biliary tract is no exception to these general statements. This subject is an important one. Warren Cole<sup>1</sup> estimates that 15 per cent of the adult population have symptoms of nonmalignant disease of the biliary tract. Throughout the United States it is one of the four conditions most frequently treated surgically.

It is my purpose to call attention to those conditions occurring in the liver and biliary tract which require urgent surgery for the optimum therapeutic result. They are acute cholecystitis, intestinal obstruction due to gallstones and associated biliary fistula, common duct obstruction, trauma of the liver, and a few rare conditions that may prove more common if kept in mind by the clinician.

Acute cholecystitis and its surgical treatment is a controversial subject. The experience of the surgical department of the New York Hospital and Cornell Uni-

versity is reported listing a few cases of the type that are said to occur rarely, as, for example, a free perforation of the gallbladder ending in a fatality, and another in a recovery; then a rare complication indeed—thrombosis of the right hepatic artery.

Intestinal obstruction due to a gallstone is invariably associated with a biliary fistula into the intestinal tract. It occurs frequently enough to necessitate its being considered in the diagnosis of intestinal obstruction in those patients with histories of long-standing gallbladder disease. Immediate operation for the relief of intestinal obstruction followed by a later operative repair of the fistula and removal of the infected gallbladder attains the best end result.

Throughout the literature, it is repeatedly stated that operation for jaundice due to calculi in the common duct should be postponed until the degree of icterus has reached a plateau. Patients with jaundice are admittedly major surgical problems, and adequate preoperative preparation should not be lacking before any operation is undertaken. There is increasing evidence, however, that additional liver damage results from waiting in obstructive jaundice, and that patients who are adequately prepared, do well after operation.

The increasing speed of transportation employed by our civilian population has

\* From the Department of Surgery of the New York Hospital and Cornell University Medical College, New York, New York.

placed major liver trauma, such as rupture, in a more important rôle as a cause of death in accidents. The old methods of treatment for this condition are no longer tenable because of their associated high mortality. There are now appearing reports that indicate that immediate and courageous action on the part of the surgeon may reduce the present mortality rate.

Then, finally, there are a few rare conditions encountered in biliary tract surgery which will be diagnosed only if continually kept in mind. By consideration which leads to diagnosis and proper treatment, additional patients may be saved. They are, for example, (a) torsion of the gallbladder, (b) biliary peritonitis due to spontaneous rupture of dilated biliary ducts, and (c) cysts of the common duct.

There is perhaps no more controversial subject in surgery today than the treatment of a patient with acute cholecystitis. The vast literature devoted to this subject alone indicates that there is evidence for and against early operation. The data to be presented are in favor of early surgical treatment. Let us begin with those patients who have been diagnosed correctly as suffering from acute cholecystitis. Over a period of slightly more than nine years, 350 patients with acute cholecystitis have been treated in the New York Hospital. A policy of early or immediate operation after preoperative preparation was employed. Our results are shown in Table 1.

TABLE 1

RESULTS IN 350 PATIENTS WITH ACUTE CHOLECYSTITIS OPERATED UPON EARLY OR IMMEDIATELY	
Patients.....	350
Deaths.....	6
Mortality.....	1.7%

These patients were representative of almost all the phases encountered in acute cholecystitis; likewise, they were of all ages from nine years to eighty-one, and with associated conditions found in such a wide age distribution. The mortality rate may be looked upon as being within a reasonable limit; however, any mortality rate, the result of therapy, should be

improved upon. Four of the six deaths mentioned might have been avoided had surgical treatment been instituted before gangrene and perforation took place. There are those<sup>2</sup> who contend that gangrene of the gallbladder rarely occurs and that perforation, if it takes place, does not result in a free escape of the gallbladder contents into the peritoneal cavity. Nevertheless, it does happen, and early in the history of biliary tract surgery, to be exact in 1844, James Duncan,<sup>3</sup> Surgeon, Royal Infirmary, Edinburgh, reported an instance of gangrene of the gallbladder which had ruptured, producing a peritonitis, followed by death. The diagnosis was made at autopsy. Doctor Samuel A. Vest, Jr.,<sup>4</sup> of Baltimore, in 1933, collected the reported cases of gangrenous cholecystitis; a total of seventy-one cases were gleaned from the literature and nine were reported as new. Twenty-three of the eighty patients died as a result of the condition, a mortality rate of 37 per cent.

The morbidity of complications in the series of 350 patients operated upon bears close analysis, for out of these comes the mortality rate. Eighty-four had gangrene of the wall of the gallbladder; and of these, twenty-two had perforation with a localized peritonitis or abscess; three had free perforation into the peritoneal cavity. One of these recovered and two died. Gangrene of a portion or of the entire gallbladder wall is a sequela of acute cholecystitis and frequently leads to perforation.

Case 1 is an instance of a patient with a free perforation of the gallbladder who was operated upon early, and who recovered:

CASE 1. H. A., N. Y. H. No. 169394. A male, age forty-three, was admitted to the hospital complaining of severe abdominal pain. Twenty-four hours before admission he began to have abdominal cramps which castor oil had not relieved. The pain continued and became more severe, localizing in the right upper quadrant. Radiation of pain from the right upper quadrant to the right shoulder was present.

Physical examination revealed a well developed, well nourished forty-three year old

male, obviously suffering from acute abdominal pain. The head was negative and eyes, ears and nose were not remarkable. The teeth were dirty with moderate dental caries; the neck also was negative. The chest expanded well. There was some suppression of breath sounds at the right base posteriorly; no râles or rhonci were present. The heart was not enlarged; the sounds were of good quality and there were no murmurs. Blood pressure was 125/80.

The abdomen showed generalized muscle resistance, most marked in the right upper quadrant where exquisite tenderness was present. No peristalsis was heard. Genitalia showed a healed incisional scar on the dorsal surface and the base of penis. A second incisional scar was present on the posterior surface of the scrotum; otherwise it was negative. Extremities were negative, reflexes physiological and rectum negative.

*Laboratory Findings.* Urine was negative; the white blood count 16,400; 86 per cent polymorphonuclears. Kline test was repeated three times before a negative result was obtained. The Wassermann test was negative on two occasions. Blood urea nitrogen was 8.

A diagnosis of acute cholecystitis with possible perforation was made. He was immediately operated upon. A large amount of bile was found in the peritoneal cavity. Bile was escaping from a perforation in an area of gangrene in the wall of the fundus of an acutely inflamed gallbladder. A cholecystectomy was performed. The patient made an uneventful recovery save for a postoperative atelectasis.

*Pathologic Examination.* Gross: The gallbladder measured 6 cm. in length and exhibited a thick wall which was markedly congested throughout. The fundus was perforated with escape of gallstones. Upon opening the organ, this perforated area was found surrounded by slough and congested mucosa which was otherwise rather smooth, pinkish and coated with inspissated yellowish material. There were numerous extensive fragmented mulberry stones in the lumen, the largest of which measured 1 cm. in diameter. The wall of the organ, on section, showed a heavy deposit of a creamy material which might represent intramural cholesterol or might also represent necrotic connective tissue. It was so yellow that it was thought to be largely cholesterol and bile salts.

The following is an instance of free perforation of the gallbladder leading to a fatal peritonitis:

CASE II. N. M., N. Y. H. No. 51896. A female, age sixty-six, was admitted to the hospital after having been under observation for several days elsewhere for severe right upper quadrant pain. A diagnosis of exophthalmic goiter had been made two years before and she had had treatment including iodine, with improvement. No history beyond eight years could be obtained in relation to the biliary tract. However, for that period she had had recurrent attacks of right upper quadrant pain associated with nausea and vomiting and occasionally jaundice. The present attack began three days before admission. There was a sudden onset of severe right upper quadrant pain radiating to the back and to the region of the right shoulder. There were nausea and vomiting. The pain became worse. On admission to the hospital the patient appeared extremely ill. Her temperature was 38.4°F. pulse, 94. There was exophthalmos and an enlarged, palpable thyroid gland. The heart was definitely enlarged. Blood pressure was 160/60. The peripheral vessels were definitely thickened and tortuous. The abdomen was somewhat distended. There was muscle spasm over the entire abdomen with marked tenderness over the right upper quadrant. There was a palpable, tender gallbladder. Rebound tenderness was referred to the right upper quadrant.

*Laboratory Findings.* Urine showed 1 plus albumin, 2 plus sugar, occasional red blood cells, many white blood cells, occasional casts, 2 plus acetone, and 1 plus bile; white blood count; 18, 800; blood urea nitrogen 15; icteric index 14; sugar 112.

It was thought that the patient was suffering from a generalized peritonitis, probably due to perforation of the gallbladder. The patient was given fluids and digitalization was begun. Five hours after admission, under local anesthesia, the abdomen was opened through a right pericostal incision. Dark bile was found free in the peritoneal cavity. There was a perforation of the acutely inflamed gallbladder near the fundus. Because of the patient's precarious condition, the gallbladder and the peritoneal cavity were drained. In spite of supportive measures the patient died two days after operation of a generalized fibrinous peritonitis. The

liver, on microscopic examination, revealed moderate fatty vacuolization. *Bacillus coli* was the predominating organism obtained from the peritoneal cavity.

been frequent recurrent episodes of right upper quadrant pain for seven weeks prior to admission. On physical examination, the patient was acutely ill, deeply jaundiced, and complained

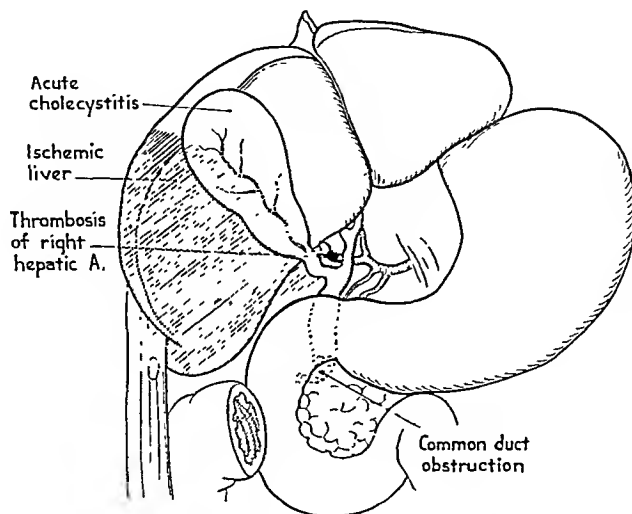


FIG. 1. Schematic drawing of acute cholecystitis. Common duct obstruction believed to have resulted in thrombosis of the right hepatic artery and accompanying ischemia of the liver.

**Discussion.** A sixty-six-year-old woman, suffering from poorly controlled hyperthyroidism, developed an acute cholecystitis with a known history of at least eight years of biliary tract disease. The acutely inflamed gallbladder perforated through a congenital sacculation, leading to a terminal peritonitis. Had the patient been operated upon before perforation occurred, the outcome might have been averted.

The following is an example of an acute cholecystitis which was not treated surgically until almost ten days after the onset. The attack of acute cholecystitis was a complication in a long-standing biliary tract disease (about twenty years). This was accompanied by another rare and fatal complication, thrombosis of the right hepatic artery.

**CASE III.** E. B., N. Y. H. No. 221902. A female, age fifty, multipara, was admitted to the hospital because of right upper quadrant pain, chills, fever and jaundice of ten days' duration. There was a history of biliary tract disease of more than twenty years. There had

of pain in the right upper quadrant. Blood pressure was 132/60. A mass could be palpated in the region of the gallbladder, which was tender. The liver edge was below the costal margin and was tender also. There was generalized abdominal tenderness throughout the abdomen.

**Laboratory Findings.** Urine: 2 plus albumin, with casts and occasional white blood cells. It was also positive for bile; red blood count 3,000,000; hemoglobin 58 per cent; white blood count 21,300; icteric index 25; cholesterol 286.

After three days of preoperative preparation, including fluids, glucose, transfusions, and vitamin K, she was transferred to the Surgical Service. Under local anesthesia, a cholecystostomy was performed, with the removal of several cholesterol stones from the gallbladder, with apparently free drainage of normal bile later. Thereafter, the patient continued to receive daily transfusions, intravenous glucose, vitamin K and other supportive measures. In spite of this, she ran a protracted course with marked elevation of temperature daily. The blood culture revealed *Bacillus lactis aerogenes*. The patient was given sulfanilamide. The infection, however, persisted. The jaundice in-

creased, reaching an icteric index of 125. Twenty-three days after operation the right large toe became gangrenous, and one day before death numerous petechiae were observed over the chest wall. Throughout her hospital course, she had marked elevation of respiratory rate, yet nothing could be demonstrated of a pathologic nature in the region of the right diaphragm.

The patient died twenty-six days after operation. At autopsy, there was found an acute cholecystitis, stones inspected in the common duct, cholangitis, and a thrombosis in the right hepatic artery with infarction of the liver. (Fig. 1.) There were multiple infarcts throughout the arterial tree.

*Discussion.* The patient, a multiparous woman of fifty, was known to have had a history of biliary tract disease of at least twenty years. At the time of admission to the Surgical Service of the hospital the patient had an acute cholecystitis and obstruction of the common duct. She also had a blood stream infection (*Bacillus lactis aerogenes*). Because she was extremely ill, a minimal type of operation was carried out under local anesthesia—a cholecystostomy. This permitted decompression of the biliary tract but, because of the overwhelming bloodstream infection, the patient, in spite of all supportive measures, continued a downhill course, and died twenty-six days later. It is reasonable to assume that the extension of the infection from the acutely inflamed gallbladder and the debilitated condition, the result of the extensive infection, led to a thrombosis of the right hepatic artery, the eventual cause of her death.

Intestinal obstruction, due to gallstones and cholecysto-intestinal fistulas, is one of the less frequent complications encountered in biliary tract disease. However, intestinal obstruction of the small bowel in particular requires urgent surgery regardless of the cause. It follows the perforation of the gallbladder into some part of the gastro-intestinal tract. As pointed out long ago by Rolleston,<sup>5</sup> this is usually the result of acute inflammation and a stone. Evidently

the stone is extruded from the gallbladder into the intestine, stomach, or whatever viscera is closest at hand. If the gallstone is small, it will be passed by rectum, or there might be, as has been reported, vomiting of a gallstone if the communication is between the gallbladder and the stomach. The common site of the fistula is in the second part of the duodenum. If the stone is sufficiently large, it may result in intestinal obstruction in the lower portion of the ileum or at the ileocecal junction.

The fistulas that remain probably close in many instances, but they may remain patent. In this event, there follows an ascending liver infection (cholangitis) which provokes continual liver damage. In addition, there is frequently partial to complete occlusion of that portion of the common duct distal to the cystic duct.

Most important in the diagnosis of small intestinal obstruction due to gallstones is a history of long-standing biliary tract disease and of one or more acute attacks. The symptoms of intestinal obstruction are not unlike those due to other causes, but there are certain findings on roentgenologic examination which, if present, confirm the diagnosis. They are: (1) distended loops of small bowel, (2) a gallstone in the terminal ileum and (3) air in the biliary tract. The following patient is an example:

CASE IV. M. C., N. Y. H. No. 290940. A white female, age sixty-one, was admitted because of vomiting and epigastric pain of two and one-half days' duration. There was a definite history of long-standing indigestion which had been much more marked during the past year, consisting of considerable belching after eating. Two and one-half days before admission the patient experienced cramping pains throughout her entire abdomen, most marked in the epigastrium. About two hours after their onset she became nauseated and vomited. The cramps persisted, as did the nausea and vomiting. She vomited twelve times during two days.

*Physical Examination.* Temperature was 38°C., pulse 84, respirations 24, blood pressure 132/90. The patient was a well developed,

slightly obese female, obviously ill. There was xanthlasma on the left eyelid. The fundi showed slight attenuation of the arterioles.

trace of albumin with 2 to 4 white blood cells per h.p.f. on admission. Subsequent specimens were negative. Hemoglobin was 15.5, red blood



FIG. 2. Roentgenogram showing (1) air in the biliary tract; (2) distended small bowel; and (3) gallstone, probably in the terminal ileum.

Ears and nose were unremarkable. The lips were dry and there was complete adentia. The tongue was coated and moderately dry. The tonsils were atrophic and the posterior pharynx clean. The neck was negative and the breasts showed no tenderness or masses. There were scattered râles at both bases of the lungs posteriorly, which tended to clear on coughing and deep breathing. The heart was normal in size, rate and rhythm; sounds were distant and there were no murmurs.  $A_2$  was greater than  $P_2$ . The abdomen was rounded and slightly tympanitic. There was moderate penniculus; a large, very tympanitic area in the epigastrium extended down below the umbilicus. There was diffuse superficial muscle soreness. Pelvic and rectal examinations were nonecontributory.

*Laboratory Findings.* Urine: There was a

count 4,500,000; white blood count 13,700; 76 per cent polymorphonuclears; blood urea nitrogen, 24-18-28-6; blood sugar 102 and 103; serum chloride 660; serum protein 6.2, 5.5, and 5.6; carbon dioxide combining power 65 volumes per cent. Stools: guaiac negative on two occasions.

*Roentgenologic Examination.* This revealed distended loops of small intestine with obstruction in the terminal portion and questionable air in the biliary tract. (Fig. 2.) The patient was treated with a Miller-Abbott tube for twenty-four hours, with partial relief of the intestinal distention. She was then operated upon for small bowel intestinal obstruction. A large gallstone, measuring 4 cm. in length and 2.5 cm. in diameter, was found impacted in the ileum. It was composed of two stones tightly

joined together. The patient made an uneventful postoperative recovery. (Fig. 3.)

*Discussion.* This is an example of a patient with a history of long-standing

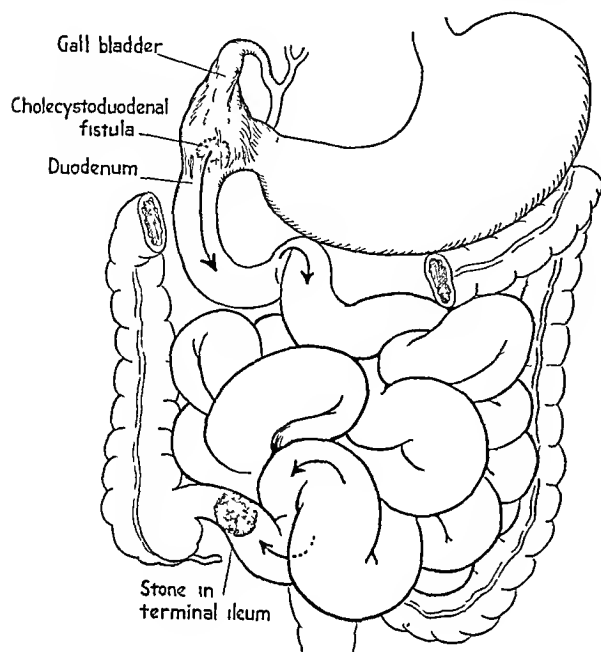


FIG. 3. Schematic drawing showing the cholecystoduodenal fistula, and dilated loops of small intestine due to gallstone in the terminal ileum. Roentgenologic examination of such a condition usually shows air in the biliary tract.

biliary tract disease. For many years she was without symptoms; then for a period of one year prior to her hospital admission she had evidence of renewed activity in a pathologic gallbladder. There is no history of an attack suggesting perforation of the gallbladder into the intestine, and her first episode was acute obstruction due to impaction of the stone in the ileum.

Surgical procedures for obstructive jaundice due to stones as well as other causes have been associated with a mortality rate much higher than that for operations upon the biliary tract without jaundice. One of the outstanding factors accounting for the mortality figure has been the tendency to hemorrhage. The use of vitamin K to correct a lowered plasma prothrombin level in these patients has reduced the mortality in almost every clinic reporting its experience. Contributing to better results in the

surgical treatment of obstructive jaundice due to calculi, is the improved preoperative preparation of the patients during which water, serum protein, and chloride imbalances are corrected, glucose reserves established and vitamin therapy instituted. In spite of this advance, however, there persists a general reluctance to operate upon the jaundiced patient. This attitude has recently been reiterated from three of the leading surgical clinics in the country. Ravdin<sup>6</sup> states: "We have come to believe that early operation, once occlusion has occurred, is not always to be desired. It has been our policy to withhold operation when the bilirubin concentration is increasing or decreasing. If it is increasing or decreasing we wait until the concentration reaches a plateau. During this period the patient is being prepared for operation. Except when suppuration is suspected, the operation is safer when hepatic function has stabilized itself against a high or low serum-bile pigment concentration and an adequate program of therapy has been carried out."

Walters and Snell<sup>7</sup> adhere to a similar policy. They state that operation should be withheld in jaundiced patients with the hope of a gradual decrease in the icteric index. Specifically, in intermittent biliary obstruction, a fall in the concentration of the serum bilirubin indicates a favorable time for operation. They advise against operation upon a patient with a rising jaundice or bilirubin. Having made these general statements, they go on to say that sometimes the rise in bilirubin may be long and continuous, and that valuable time may be lost before operation is undertaken. Finally, they conclude that operation should be undertaken in jaundiced patients only by the surgeon of wide experience who relies on his judgment.

Cole<sup>8</sup> suggests the advisability of earlier operation in certain instances. He writes: "The difficulty in determining the opportune time for operation and the frequency of hepatic insufficiency and other diseases require an unusual amount of care and judgment in taking care of this condition.

Not infrequently infection of a type such as suppurative cholangitis develops in such a fulminating way that emergency operations are necessary."

A summary of the general practice, expressed by many writers in the current literature, reflects an attitude which is less straightlaced than it was ten years ago; nevertheless, it still justifies procrastination which permits liver damage.

The effect of obstructing the flow of bile in dogs by ligation of the bile ducts upon the level of plasma prothrombin has been demonstrated by Lord, Andrus, and Moore.<sup>9</sup> The level of plasma prothrombin gradually fell over a period of one hundred days to a value of less than 20, and the animal died. (Chart 1.) When these same investigators diverted the bile from the duodenum by means of a cholecystonephrostomy, the plasma prothrombin fell more slowly and the animal survived 165 days. (Chart 2.) Obstructive jaundice in animals at least hastens liver dysfunction which, we believe, is best measured today by the plasma prothrombin level.

with its metabolism of fat so that fat infiltration takes place. If infection is already present, obstruction to the bile flow is even more detrimental.

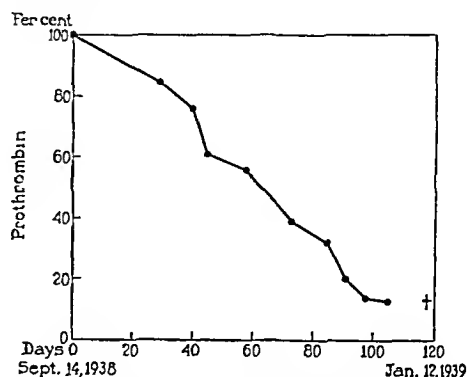


CHART 1. Effect of ligation of the common bile duct on the level of the plasma prothrombin in a dog. (Lord, Andrus and Moore.<sup>9</sup>)

The delay in surgery is not alone the fault of the surgeon. Certainly, the fact that diagnosis in jaundice cases is not always accurate does deter one from prompt operation, because a general anesthesia and an operative procedure upon the

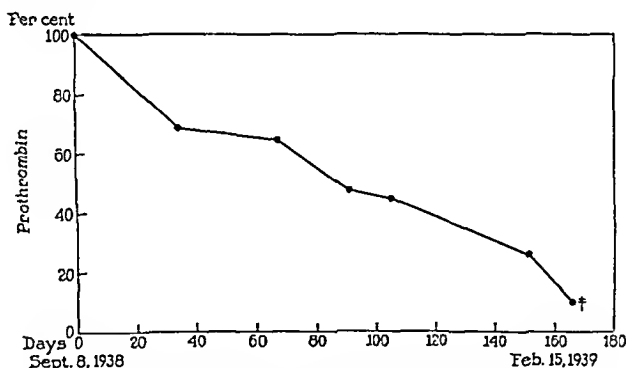


CHART 11. Effect of an internal biliary fistula on the level of the plasma prothrombin. (Lord, Andrus and Moore.<sup>9</sup>)

It is well to remember that the increase in ductal pressure which follows common duct occlusion causes a retardation of the portal blood which may be followed by local hepatic anoxia. The liver cells are known to be extremely sensitive to oxygen want, and further liver damage follows. This renders the liver cell less capable of holding and storing the glycogen, it reduces its store of mobile protein and interferes

abdomen should be avoided in nonobstructive jaundice. Thus, what has been said is directed toward the patient upon whom there has been made the diagnosis of jaundice due to a stone in the common duct.

Jaundice, in such instances, is an indication for surgery in an attempt to prevent further damage to the liver; as long as jaundice persists, there will be further liver

damage. It may be contended that an operative procedure which will relieve the jaundice without removing the cause is sometimes justifiable; and if we draw conclusions from simple experiments on animals as noted above, a biliary fistula is preferable to persistent obstructive jaundice. Indeed, if replacement therapy, such as feeding whole bile or using bile-fractions as substitutes, is employed, the patient will be benefited. For those patients, who are over fifty, and come under care markedly jaundiced because of stone or stones in the bile ducts, such a compromising procedure may sometimes avert a fatality. Jaundice in the aged patient, with a scarred liver, may be a serious problem with only a small margin of safety. These patients, in particular, should be spared liver damage insofar as it is possible to do so.

#### LIVER TRAUMA

Injuries to the liver have recently come into greater prominence because of the increasing frequency of the major trauma in war casualties in Europe, and the ever increasing number of automobile accidents in this country. Liver injuries previously were more often inflicted by knife or gunshot in contrast to the subcutaneous or contusion wounds of today. In war areas impacts due to explosions, and, in civilian life, to rapid means of transportation, account for the increase in injuries to the liver.<sup>10</sup> These may be grouped as follows: (a) rupture; capsule and liver parenchyma are ruptured; (b) subscapular rupture; rupture of parenchyma, capsule intact; (c) deep or central ruptures; without injury to the capsule or periphery of the parenchyma.

The immediate danger from liver rupture is the exsanguinating hemorrhage produced and the accompanying shock. These patients who died within twelve hours probably do so because of loss of blood. Furtwaengler<sup>11</sup> believes that damaged liver causes vascular spasm and renal ischemia which is followed by kidney shut-down. Orr and Helwig<sup>12</sup> hold a similar view in

that they believe that a toxin liberated from the liver completely nullifies the detoxifying function of the kidney. Boyce<sup>13</sup> contends that there is liver failure throwing a greater burden on the kidney which has been rendered less efficient by the toxic material liberated by the damaged liver.

*Diagnosis.* These patients are to be found among the major trauma accidents. A history of injuries of sudden impact, be it from a means of transit, a fall, or forces of compression, as in explosions from bombings, should be sufficient grounds for seriously considering liver injury. The true rupture of the liver, including capsule and parenchyma, leads to hemorrhage and shock. Shock is the first symptom, followed by severe anemia. External injury may be lacking, but there is evidence of intra-abdominal bleeding, particularly in the flanks and cul-de-sac. Pain in the right upper quadrant is frequent, as well as pain referred to the right shoulder.

*Treatment.* Replacement of blood loss should be instituted before operation is begun and continued until the hemorrhage is controlled and the patient's condition improved. Ruptures and large tears are probably best treated by a light tamponade of gauze. Placing omentum in the defect will sometimes diminish the hemorrhage. Suture of the liver by massive mattress sutures has been successful. However, care must be exercised not to add further damage to the liver. Attempts at suture were first suggested by Postempski,<sup>14</sup> in 1885, and very little encouragement has appeared in the literature since. Recently, in our experimental laboratory, Andrus and McSwain have used a ribbon-gut carried by a wide, blunt needle in the liver of dogs with quite satisfactory results. We would, on indication, attempt it in a patient. Resection of most of the left lobe has been accomplished successfully. Drainage of the peritoneal cavity in an attempt to avert a bile peritonitis is a well established practice. (Fig. 4.)

In the examination of the suspected liver injury, the posterior and inferior

aspect of the liver should not be overlooked, for it has been pointed out that this is one of the most common sites of unob-

properly with other intra-abdominal injuries. Frequently, injury to the liver occurs with other intra-abdominal catas-

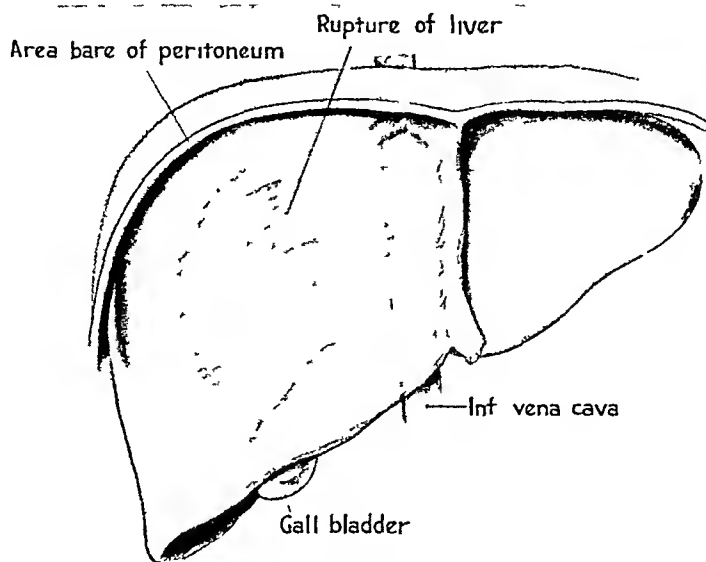


FIG. 4. Drawing indicating nonperitonealized area of liver, a common site of liver rupture sometimes overlooked.



FIG. 5. Torsion of the gallbladder. On section of the organ a black color is found to involve the mucosa and the greatly thickened wall of the organ. (From Hun.<sup>19</sup>)

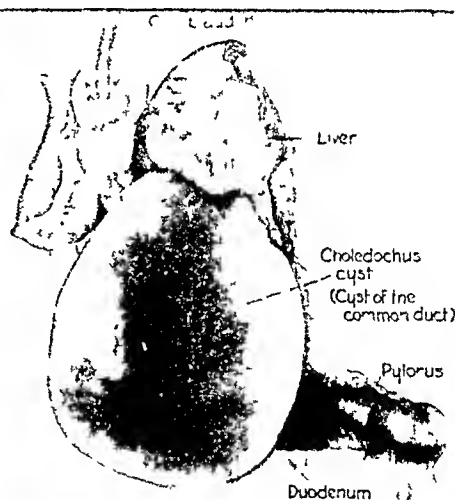


FIG. 6. Cholelith cyst. (From Bodley.<sup>21</sup>)

served injury. (Fig. 4.) The removal of the damaged, devitalized, or necrotic liver should be stressed; one of the outstanding results was reported by Branch of Boston, who removed 345 Gm. from the left lobe of the liver in a child of seven. Important as it is to locate and treat the liver injury, one should not fail to search for and deal

trophes such as a perforated viscus or rupture of the spleen.

**Prognosis.** The various case series reported are evidence of the seriousness of major liver trauma. Krieg,<sup>15</sup> of Detroit, reports sixty cases, with a total mortality of 61.6 per cent, and an operative mortality of 56.6 per cent. Seventy-three per cent of the deaths occurred within seventy-two hours. O'Neill<sup>16</sup> collected one hundred

cases from the Los Angeles General Hospital over a ten-year period. Thirty-two of these patients were operated upon, with a mortality rate of 40 per cent. The remaining sixty-eight were from the autopsy records. From these cases it may be concluded that most of the "ruptures" of the liver were along the posterior and inferior surface. The nature and extent of the injury play an important rôle in the prognosis.

If the patient survives the immediate shock with hemorrhage, signs of peritonitis appear and increase with the escape of bile into the peritoneal cavity. If the patient survives the first few hours and recovers from the blood loss and shock, there is next a period during which there may be death due to liver failure or complete renal shutdown. Nor does survival of these two periods insure recovery, because infection and resulting peritonitis, local or generalized, may follow. When a *Clostridium welchii* peritonitis occurs, the end result is almost invariably death.

O'Neill<sup>16</sup> has constructed the following table (Table II) which is probably quite representative for our urban areas, and accounts for the manner in which the accidents occur in a civilian population:

TABLE II

TYPES OF VIOLENCE IN 100 CASES OF RUPTURED LIVER	
Pedestrian versus automobile.....	46
Automobile versus automobile.....	20
Bicycle versus automobile.....	4
Blow in epigastrium during fight.....	4
Falling from a height.....	3
Thrown against a steering wheel.....	3
Miscellaneous.....	20

The present war is producing, and will probably continue to produce, many liver injuries. Detailed case reports are now beginning to appear. Roscoe Clark,<sup>17</sup> from the British Post-Graduate School, reports a case of subcutaneous rupture of the liver treated surgically, with recovery, and complicated by a liver sequestrum which was removed thirty-seven days after the first operation. Fragmentation of the liver is often followed by autolysis and death. This experience, together with Branch's<sup>18</sup>

two cases, one in which almost half the liver of a child was removed, and another in which a portion was removed and another portion left behind, suggests that complete removal of liver fragments in liver trauma is imperative for complete recovery. These new problems may be solved in part in the experimental laboratory.

*Rare Conditions.* Finally, in our consideration, are those conditions that are rare and seldom encountered in even large series of patients with biliary tract disease. These, unfortunately, are not often diagnosed before operation or autopsy. There are three to be briefly dealt with: (1) torsion of the gallbladder, (2) choledochus cyst and (3) bile peritonitis due to idiopathic rupture of a bile duct.

*Torsion of the Gallbladder.* Since the original description of torsion of the gallbladder, by Wendel,<sup>20</sup> in 1898, less than sixty cases have been reported. For torsion to take place, the gallbladder must be abnormally free so it may rotate, and thus twist its supporting pedicle which is made up of the cystic duct and vessels. Over half of the reported cases have been in patients over sixty years of age. The onset of pain in the abdomen is sudden, becomes severe and is persistent, usually accompanied by vomiting. A mass is often palpable in the gallbladder region, with varying degrees of tenderness and rigidity of the abdominal wall. It is doubtful if one could distinguish it from a straightforward cholecystitis.

At operation, the gallbladder is large, discolored and tense; its blood supply is occluded, and if this has persisted for long, the organ will show areas of gangrene. (Fig. 5.) Less than half the patients have had stones. Operation is simple and the end results satisfactory. Cases coming to autopsy show a rupture of the gallbladder and generalized peritonitis. We have encountered one instance in a series of 1,550 patients.

*Choledochus Cyst.* Over 130 cases have been reported. Almost all the patients had symptoms dating back to childhood, although they presented themselves for

treatment at all ages. Bodley<sup>21</sup> and Gross<sup>22</sup> (Fig. 6) have written extensively on the subject. They believe that a congenital defect in the duct such as a narrowing of the lumen or a lack of the normal structures in the wall constitute the primary defect. The cystic dilatation results in jaundice and liver damage. As it enlarges, encroachment on surrounding structures may produce a variety of symptoms. Traumatic rupture of such a cyst has been reported by Blocker, Williams and Williams,<sup>24</sup> of Texas. Short-circuiting operations and decompression have been employed with discouraging results. Choleddoco-enterostomy and anastomosing of the cyst to the intestine has been employed with some success. It may be comforting to know that Judd and Green<sup>23</sup> encountered it only once in 17,381 operations; we have not had a single case in our series of patients. The case reported herewith is from Presbyterian Hospital, and is contributed by Dr. Beverly Smith:

CASE V. M. D., Presbyterian Hospital No. 621745. A single female, age twenty, was admitted to the Presbyterian Hospital, September 23, 1940, complaining of a mass in her right upper abdomen which had steadily enlarged to its present size during the past five weeks, jaundice for three weeks, itching, loss of appetite, loss of weight, and discomfort in the region of the abdominal mass. Her past health had been excellent except for an attack of painless jaundice lasting one month, in 1932, at the age of twelve. She was deeply jaundiced at that time, her skin itched, but she could not recall having had clay-colored stools. Other than this she had always been healthy, active and engaged in strenuous outdoor exercise.

About August 16, 1940, she noticed a hard nontender mass in her right upper quadrant, measuring about 2 by 2 inches, just below the costal margin. In a week's time it doubled in size. In two more weeks it filled the right half of the abdomen. During the second week that she noticed the mass she became jaundiced. Her skin itched and the jaundice steadily deepened. Three weeks after she noticed the mass and one week after onset of the jaundice, she noted clay-colored stools. She had never been really acutely ill, and was nauseated and vomited only after taking certain fatty foods.

When she first noted the mass she felt a dull aching abdominal pain in this region, but this subsided and had not recurred. She had been constipated, lost thirty pounds, and her appetite had failed. There had been no tarry stools.

*Physical Examination.* The patient was thin, deeply jaundiced and chronically ill. There were many scratch marks over the whole of her body. A nontender, firm, slightly irregular mass, measuring 25.5 by 30.5 cm., which gave the sensation of containing fluid, extended from the right costal margin to the right anterior superior iliac spine, beyond the umbilicus, and could be balloted in the right flank. A diagnosis of a cyst of the right upper quadrant was made, and was considered to be either pancreatic, hepatic, choleddochal or mesenteric.

*Laboratory Findings.* Red blood count 3,000,000; hemoglobin 55 per cent; white blood count 11,900; polymorphonuclears 55 per cent; lymphocytes 34 per cent; Kline negative. Prothrombin was within normal limits. Roentgenologic examination showed that the abdominal mass displaced the stomach and duodenum forward and to the left, and the transverse colon downward. The mass could be separated from the liver. The patient was given bile salts, vitamin K and a transfusion, and because of her rising serum bilirubin was operated upon September 27, 1940, at which time a cystic mass was encountered which was too large to be delimited. It was aspirated. The first fluid was white mucoid and was followed by dark brown fluid without odor. The section aspirated 5,200 cc. of similar fluid. The duodenum lay anterior on and to the left of the cyst wall, the small intestines were pushed to the left into the pelvis, the transverse colon was below it and also in the pelvis, the stomach was upward and to the left, the gallbladder was in its normal position. It was edematous and about twice the normal size. The liver was not apparently cirrhotic. Its lobes were normal. About 100 cc. of bile-stained, clear, nonodorous fluid was evacuated from the peritoneal cavity.

The patient's immediate postoperative course was satisfactory, and thirty-seven days after the first operation a second procedure was undertaken. This time the cyst was anastomosed to the duodenum, and its opening to the exterior closed. The patient was discharged forty-two days after her second operation, markedly improved.

*Discussion.* This patient reached adult life before a cyst of the common duct became sufficiently large to produce symptoms. The treatment, consisting of decompression by drainage of the cyst and later anastomosing the cyst to the duodenum, has given a very satisfactory result.

*Bile Peritonitis.* The presence of bile in the peritoneal cavity, not originating from the gallbladder, is perhaps not as rare as the infrequent reports in the literature might indicate. Escape of bile from the bile ducts may result from their rupture due to trauma, infection, or back pressure, or a combination of these. One can readily see how trauma may produce this picture, or back pressure, due to progressive obstruction as caused by neoplasm, or common duct stone, especially in the debilitated; but it is difficult to understand in patients without a history of trauma and without demonstrable common duct obstruction.

The following is a case report of a patient of Dr. Ralph Bowers at the New York Hospital:

CASE VI. A. A., N. Y. H. No. 301032. A white female, age seventy-five, was admitted complaining of severe generalized abdominal pain for twelve hours. Her past history was significant in that she had had indigestion for many years. Four months before she had recovered from bronchopneumonia. Her present illness dated back to the day before admission when, about one hour after breakfast, she had sudden, severe generalized abdominal pain. When seen by her local doctor she presented a clinical picture of shock. She vomited during the day, remained acutely ill, with only a slight elevation in temperature. She was then brought to the hospital. On admission, her temperature was 38.2°C., pulse 110, blood pressure 168/90. The abnormal findings were limited to the abdomen. This was full but not distended. There was generalized abdominal tenderness with some muscular resistance, most marked in the epigastrium and in the right lower quadrant. Rebound tenderness was referred to this area. The remainder of the examination was noncontributory.

*Laboratory Findings.* Urinalysis showed a very faint trace of albumin, a trace of sugar;

hemoglobin 16.5 per cent; red blood count 5,500,000; white blood count 11,900; polymorphonuclears 88; urea nitrogen 9; serum protein 4.8 per cent; chlorides 660; prothrombin 53 per cent. Culture of fluid from the gallbladder wound showed *Staphylococcus aureus* nonhemolytic.

Because the patient presented a picture of an acute condition of the abdomen, suggesting an acute cholecystitis with possible perforation, she was subjected to a celiotomy. A bile peritonitis was found, with a pancreatitis. The gallbladder was edematous, the wall thickened, and the organ dilated. A cholecystostomy was performed, after making a careful search for the source of the escape of bile. This was not found. Her postoperative course was rather stormy and she died four days after the operation. At autopsy, a defect was found in the junction of the cystic and common duct. It was concluded, by the pathologist, that there had been a rupture of the cystic duct and that this was the source of a large amount of bile found free in the peritoneal cavity. In addition there was found a pancreatic fat necrosis and acute cholecystitis.

*Discussion.* This seventy-five-year-old patient presented the symptoms of an acute condition of the abdomen necessitating surgical exploration. The bile peritonitis which was found was the result of a spontaneous rupture in the biliary tract.

#### CONCLUSION

There are several conditions encountered in the surgery of the biliary tract that may be better treated if a policy of early operation is followed. In the successful employment of such a policy preoperative preparation must always be adequate and the contraindications to surgical therapy recognized. Each patient is an individual and requires attention peculiar to his needs. If these facts are kept in mind, earlier surgery in acute cholecystitis, intestinal obstruction due to gallstones and associated biliary surgery, common duct obstruction, trauma of the liver, torsion of the gallbladder, biliary peritonitis and cysts of the common duct may further reduce our present morbidity and mortality figures.

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# THE TREATMENT OF BURNS FOR MEDICAL DEFENSE UNIT\*

WITH REFERENCE TO EARLY AND LATE THERAPY

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THERE has been so much confusion among the members of our Medical Defense Unit as regards the treatment

more simplified without employing a great many preparations which might interfere with successive treatment of the burn area at the casualty stations and hospitals. This plan gives us a workable basis for treatment of burns.

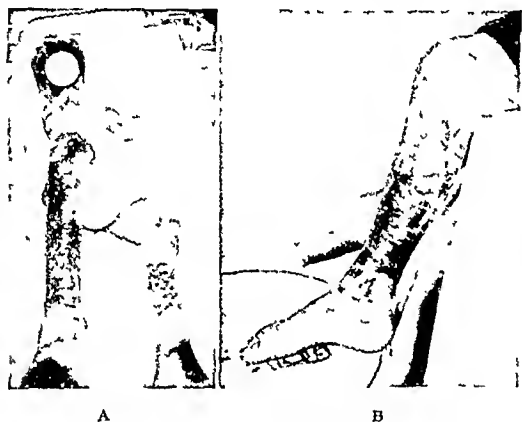


FIG. 1. A, shows condition of legs of boy nine years of age with infected burn ulcers, two months after clothing caught fire with acetylene torch. Area was primarily prepared with saline and potassium permanganate, 1-2500 solution. A combination of split and implantation grafts were used to heal the area. B, shows result after grafting; functional result excellent.

of burns that I was asked to prepare a concise and compact outline illustrating treatment of burns at first-aid posts, casualty stations and hospital stations, keeping in mind the equipment available as designated by Bulletin No. 2 appearing in the Journal of the American Medical Association, November 22, 1941, which was prepared by the office of Civilian Defense, Washington, D. C.

As one will recognize we have deviated slightly from the equipment listed, not because we believe the list unsatisfactory, but because we are of the opinion that the treatment at the first-aid post can be still

## OUTLINES FOR TREATMENT OF BURNS

### Principles of Treatment:

- A. Saving of life
- B. Protection of burned area against bacterial invasion
- C. Prevent deformity, promote healing and restore function by early skin grafting

## EMERGENCY THERAPY

### FIRST-AID POST

#### A. Local:

- (1) Remove clothing, cut away if necessary
- (2) Wash surrounding skin with soap and water if available.
- (3) Sulfathiazole 10 per cent-benzocaine 1 per cent in a water soluble jelly

or

Sulfanilamide or sulfathiazole powder in salt shaker applied to burn area (fine spray)

- (4) Application of sterile dressing, towel or sheet
- (5) Ophthalmic ointment, boric acid 5 per cent in eyes, if burn of face

#### B. General:

- (1) Relief of pain  
Morphine sulfate gr.  $\frac{1}{4}$  to gr. 1.

\* Prepared by the Plastic Surgery Department of the Allentown Hospital Medical Defense Unit, January, 1942.

- (2) Relief of cold (blankets, hot water bottles, etc.)

## CASUALTY STATION

## A. Local (mild burn)—ambulatory—aseptic technic

- (1) Removal of dressing (use sterile saline if necessary)
- (2) Soap and water (wash surrounding skin and burn area)
- (3) Gentle débridement
- (4) Local applications to burn area.
  - (a) Sulfathiazole 10 per cent-benzocaine 1 per cent in a water soluble jelly

or

Sulfanilamide or sulfathiazole powder in salt shaker applied to burn area and covered with tulle gras mesh gauze.

or

- (b) Tannic acid jelly (A. M. A. emergency equipment); (not on face, hands or genitalia)

- (5) Application of sterile dressing
- (6) Evacuation to own physician

## B. Local (severe burn):

- (1) Moisten dressings which had sulfathiazole or sulfanilamide powder previously applied with warm saline; rebandage
- (2) Do not disturb dressings in which above jelly was used
- (3) Use aseptic technic

## C. General (severe burn)—Nonambulatory

- (1) Relief of pain and supportive treatment
- (2) Relief of cold
- (3) Plasma injection if available
- (4) Evacuation to hospital
- (5) Sulfanilamide Gm. 1 every four hours by mouth

## LATE THERAPY AT HOSPITAL

## A. General treatment:

- (1) Relief of pain with supportive treatment

## (2) Transfusions

- (a) Plasma
- (b) Human serum-albumin

## (3) Laboratory determinations

- (a) Hematocrit
- (b) Serum protein
- (c) Plasma chloride
- (d) Non protein nitrogen, icteric index, carbon dioxide combining power
- (e) Urine examination

## (4) Oxygen for anoxia

## (5) Adrenal cortical extract

## (6) Heat cradle

## (7) Antitetanic serum

## (8) Sulfanilamide Gm. 1 every four hours by mouth

## B. Local treatment—aseptic technic:

## (1) Operating room—general routine

- (a) Anesthetic, if necessary; (avoid if possible).

- (b) Remove dressings and wash surrounding areas

- (c) Gentle débridement with soap and water wash to burn area, followed by normal saline

- (d) Remove grease with ether, benzine or some other detergent

## (2) Operating room—local routine

## Trunk:

- (a) Grease mesh gauze and sterile dressings saturated with .8 per cent sulfanilamide in saline, apply *pressure*. (Incorporate perforated tubes so that irrigation can be continued without disturbing dressings), apply *pressure* or

- (b) Tannic acid 5 per cent, freshly prepared—silver nitrate 10 per cent. This should not be used in severe third degree burns and not on genitalia; use sulfathiazole jelly on genitalia

## Face:

- (a) Grease mesh gauze (tulle gras) Dressings applied and repeatedly moistened with .8 per cent

sulfanilamide in saline or normal saline alone.

- (b) Triple dye—(gentian violet 2 per cent—brilliant green 1 per cent—neutral acriflavine .1 per cent)
- (c) Boric acid ophthalmic ointment 5 per cent with preliminary atropine 1 per cent to dilate pupil

#### *Extremities:*

- (a) Grease gauze (tulle gras fine mesh) covering  
Sprayed with sulfanilamide and application of pressure dressing on hands and feet. Dressings may be moistened at four-hour intervals with .8 per cent sulfanilamide in saline through perforated tubes so as not to disturb dressings. May be used on legs and arms.
- (b) Triple dye, to upper arms and thighs
- (c) Immobilization: proper splinting with fingers and toes separated
- (3) Operating room—special routine (miscellaneous burns)
  - (a) Mustard gas
    - (1) Bleaching powder (60 gr. to pt.)
    - (2) Gentian violet 1 to 2 per cent or triple-dye
  - (b) Lewisite burns
    - (1) Hydrogen peroxide
    - (2) Triple-dye
  - (c) Phosgene burns
    - (1) Sodium bicarbonate solution

*Note:* Treat the burn in such a manner as to stimulate healing as soon as possible or to make the area receptive for early skin graft.

#### PRINCIPLES OF TREATMENT

The saving of life is probably the most important factor that must be taken into consideration when treating the patient. There is no question but that the general

treatment is of primary importance, but together with that we must incorporate a satisfactory local treatment which will make the patient more comfortable and tend to avoid manifestations of the symptoms which may endanger life.

The protection of the burn area against bacterial invasion is of like importance and involves the application of local treatment as outlined. The prevention of deformity, the promotion of healing and the restoration of function by early skin grafting is a third principle worth consideration. This plan depends a great deal on the saving of the individual's life and the method employed to cover the burn area. All three of these principles are very closely allied and must be considered in all treatment of burns.

#### FIRST-AID POST

The first-aid post treatment covers various technics which are sufficiently satisfactory in that they provide for the welfare of the patient in the least time under the most unusual circumstances and with the provision that one can do no harm as regards the final disposition of the case. I wish to stress simplicity in treatment at the first-aid posts and the application of a sterile dressing is apparently the least and best I can advise.

#### CASUALTY STATION

Emergency therapy at the casualty station would depend a great deal upon the time the patient will remain at this point, the severity of the burn and the equipment on hand. Naturally, I believe that the equipment must vary according to the distance of the casualty station from the hospital and the capability of the hospital to handle the emergencies. It may be necessary to perform a great deal more treatment especially as regards the general treatment of burns and for that reason we should apply flexibility and provide plasma for use, if necessary. A large percentage of the patients seen at the casualty station will be able, after some additional treat-



FIG. 2. A, shows condition of burn area when referred for skin grafting. Arcas were prepared with saline; a split graft was applied with partial loss. Granulating arcas were implanted with graft. B, shows area healed with some scar contracture which was improved with massage.

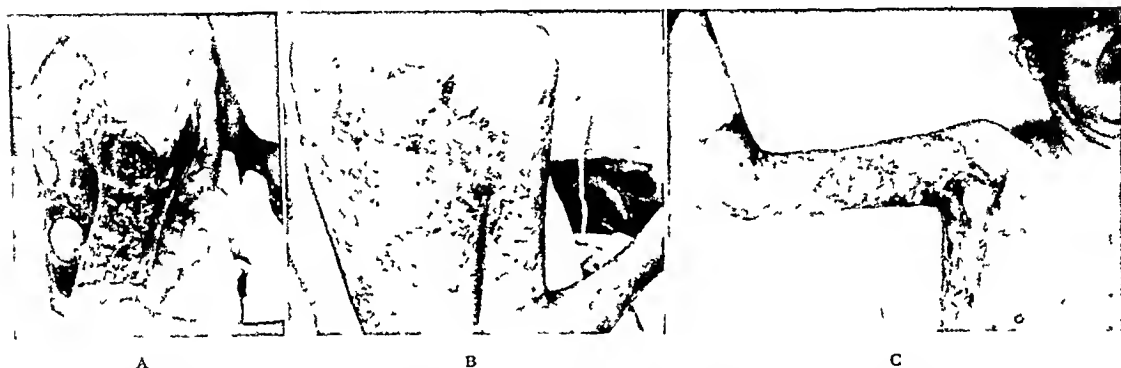


FIG. 3. A, shows condition of burn area in a forty-three year old individual, approximately two and one-half months after admission to hospital. Granulating tissue was abundant, badly infected and very soft. B, shows area healed after application of split grafts and implantation grafts. Cubital space in axilla shows extensive scar contracture. C, scar tissue in axilla was excised and split grafts applied. The functional result was satisfactory. The patient has developed a slight contracture which can be repaired at a later date. This does not conflict with his routine work. Cubital space shows a previously applied split graft for release of scar contracture.



FIG. 4. A, infected burn area when admitted to hospital. There was marked infection and heavy granulating tissue. Implantation grafts were inserted to heal the area. The patient was very uncooperative and in very poor physical condition. B, condition of chest and neck after healing of the burn. There was considerable keloid formation with chin contracted on chest. The general condition of the patient was improved and she was re-admitted for further operation. The scar tissue in neck and upper chest was excised and two split grafts applied to raw area. C, shows condition after above operation with satisfactory neck line. The patient was very uncooperative and slight contracture resulted in spite of cast to retain neck in position. X-ray therapy was instituted. The scar over chest can be replaced later if necessary if patient desires.

ment, to be evacuated to their private physician instead of the hospital, and this will help a great deal in not imposing upon

#### HOSPITAL TREATMENT

The hospital treatment of the burn is outlined in a manner to include general treatment first, which is considered the most important as regards the saving of the patient's life. This outline is fairly well standardized among the members of the medical profession and should offer very little criticism. The local treatment, which is of secondary importance, is outlined to give the surgeon a working basis and a choice of material always available. Naturally, there are many men who treat their burns differently, but I have attempted to incorporate the materials for application which I have found very satisfactory in the hospital treatment of burns.

#### LATE THERAPY

I have included this title to cover the type of burns that are not healed by the methods employed or that are healed with marked scar contracture, both of which will necessitate the employment of some form of reconstructive surgery.

*Raw Surfaces.* The principles involved in the treatment of the raw area resulting from the treatment of the burn is primarily

the resources of the hospital. The team in charge of the casualty station must employ their own judgment in determining this

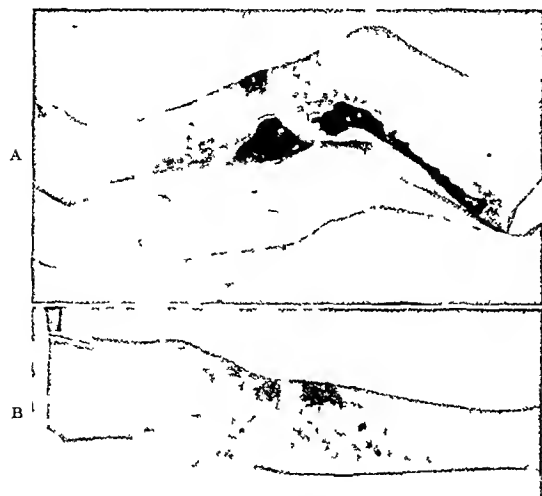


FIG. 5. A, condition of leg with badly infected areas still covered with the results of primary local application. The eschar under these areas was excised and raw surfaces immediately covered with split grafts. B, shows condition of leg after healing. Grafts took very satisfactorily.

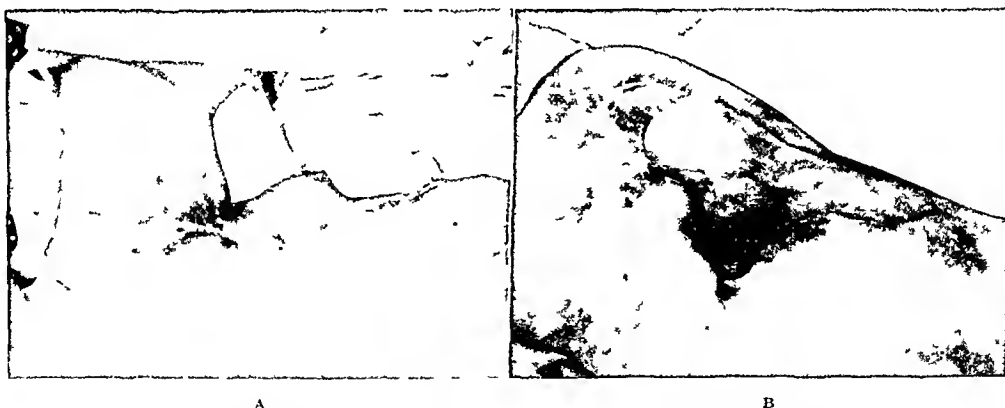


FIG. 6 A, scar contracture following burn of right side of abdomen, inguinal region and thigh. Web formation not applicable for Z-plasty. B, shows condition of area after excision of scar and application of two split grafts.

factor of evacuation by consideration of the extent and severity of the burn and the condition of the patient, always remembering that a mild burn may be just as severe as an extensive burn as far as the patient's life is concerned.

the preparation of the area to make it receptive for skin grafting. There are many methods advocated in preparing this area, but probably the simplest and the best is saline solution. Dakin's solution is frequently employed and at times we utilize

potassium permanganate, 1-2500 solution; also .8 per cent sulfanilamide in saline with gauze bandage pressure dressing.

The principles involved in the treatment have been discussed as regards the first-aid post, casualty station and hospital.

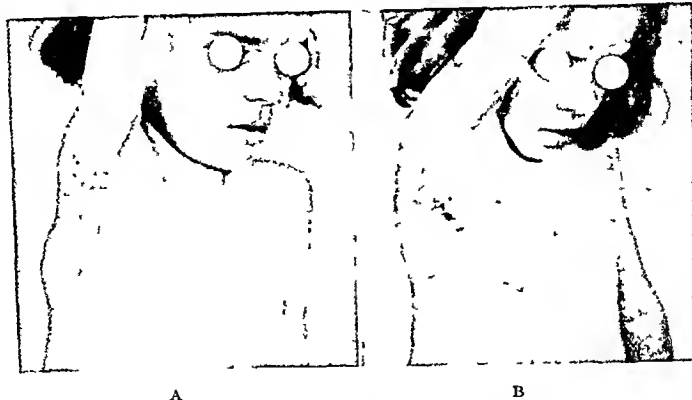


FIG. 7. A, scar contracture following burn with web formation. B, shows result following Z-plasty.

As soon as all exudate is removed from the raw area and healthy granulations appear, the area is skin grafted. At this time the general condition of the patient is also of vast importance and measures should be employed to place the patient in the best psychological attitude and best physical condition possible. This is a very important determination as regards the end result.

**Scar Contractures.** This should be minimized if one skin grafts the raw area early enough prior to the time the scar contractures may start to develop. Should these patients be seen after the development of the scar contractures every effort should be made to build up their general condition prior to instituting any operative procedures. The methods of choice should always be primarily the utilization of all available skin in the region of the scar, either in the form of a Z-plasty or by sliding flaps of good skin to cover the raw areas produced by the excision of the scar. Secondly, if this is impractical, the scar should be excised and the raw area produced covered with some form of skin grafting or flap, the type depending upon the judgment of the operator.

#### SUMMARY

I have attempted to present an outline covering the treatment of burns, especially applicable to a Medical Defense Unit.

A few cases have been presented to illustrate the late therapy employed in our clinic to promote healing, prevent deformity and restore function.

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# DIETS IN GENERAL SURGERY

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NO one can seriously doubt the great importance of diet in the care of surgical patients. The day when the postoperative patient first becomes interested in foods frequently marks the beginning of his convalescence and is a cheering time for his medical attendant. Certain especially graded dietaries, as those following gastric surgery, are essential to the patient's recovery.

Rational systems of feedings are far from new and represent accumulated clinical experience of centuries, modified by scientific research into nutritional requirements, the product of recent decades.

While there is nothing novel in either the substance or arrangement of the dietary régimes listed in this article, we believe that a need exists for their representation to the medical profession in article form. Apparently, few physicians and fewer surgeons make use of the several excellent works on applied nutrition or of the sections on dietaries in surgical texts. This may be in part the fault of these very texts. They tend to be too cumbersome for the busy surgeons and the actual diet lists too scattered to be readily available.

Many hospitals have met this need by preparing surgical diet lists worked out by their graduate dietitians. By and large these are very satisfactory.

A number of our staff men at the Massachusetts Memorial Hospitals, where these dietaries have been used for several years, have found it convenient and valuable to maintain a supply of mimeographed copies of such diets in their offices for distribution to patients. In this way the patient believes that his diet has been prescribed in a constructive fashion. He is not told to "go home, be careful about your food, do not eat this and that."

The general surgical diets may be utilized

in a large proportion of surgical cases both preoperatively and postoperatively. For example, a patient who has just been admitted with a diagnosis of partially obstructing gastric lesion should be kept on the liquid diet until his condition has been evaluated properly. On the other hand, a healthy man in the hospital for an elective herniorrhaphy two days hence should have the full house diet.

After appendectomy a patient may be started on restricted liquid diet within a very few hours depending somewhat upon the type of anesthesia given. The next day he will usually tolerate and appreciate the full liquid diet, omitting, however, fruit juices and cold or iced liquids. Most patients immediately after abdominal operations will have less gastrointestinal spasm and fewer gas pains if liquids are hot or at room temperature. As Mason<sup>1</sup> points out, tepid liquids frequently are nauseating and should be avoided. Some elements of the soft diet can be taken as early as thirty-six hours postoperatively and will lead to return of normal peristalsis sooner than if diet is restricted to liquids for two or three days. The full house diet is best tolerated after a spontaneous or aided bowel evacuation has occurred. After uncomplicated herniorrhaphies or many orthopedic operations, for example, the diets should be liberalized earlier.

## SPASTIC COLON DIET

The condition of spastic or irritable colon is of extraordinarily frequent occurrence among patients coming to most general surgeons. It is undoubtedly an important member of the large family of functional gastrointestinal disturbances. It offers, frequently, a difficult problem in diagnosis, simulating as it does, appendicitis, cholecystitis, organic stomach disorder and

bowel disease. Once such a functional diagnosis is made, the patient's treatment rightly becomes medical and in many cases that finally the patient is receiving generous, well balanced meals, omitting some obviously hard-to-digest foods.

GENERAL SURGICAL DIET

Type of Food	Restricted Liquid Diet	Liquid Diet	Soft Diet	House Diet
Cereals	Cereal Water	Gruels well strained	Cereals Rice Macaroni Soda crackers White bread	Soft diet plus Prepared Cereals Other breads
Potatoes			Baked Mashed	All forms except fried
Vegetables			Pureed Vegetables	All except very coarse Include celery and lettuce
Desserts	Ices Jello  (No iced liquids directly after abd. operations)	Ices Ice cream Jello Junket	Liquid diet plus Milk puddings Custards Gelatin desserts Sponge cake Angel food cake (all without fruit)	Soft diet plus All simple desserts Jellies and some jam Fruit juices Cooked and raw fruit
Milk Cheese Eggs Meat	Albumins (egg white added to above)	Milk Cream Malted milk Buttermilk Acidophilus Cocoa Egg nogs	Liquid diet plus Eggs, soft cooked Cottage cheese Butter	Soft diet plus Various cheeses Broiled, boiled or roasted meats Fish or poultry (except fried)
Soups	Clear broth	Clear broth Well strained soups	Same as liquid diet	All soups
Miscellaneous and Beverages	Tea Coffee Postum Beef juice Water Bouillon	Tea Coffee Postum Gingerale	Same as liquid diet	Same as liquid diet plus Olives Mayonnaise Tomato ketchup

should be conducted by the internist. At any rate, the surgeon should know what can be accomplished for these uncomfortable patients by a careful medical régime, which is largely dietary. The majority of such patients can be relieved of their pain, their gas and distress and frequently of their chronic constipation by the proper adherence to this régime. A bland diet with regimentation is the foundation of the treatment. This diet is additive in scope so

#### SPASTIC COLON DIET AND MEDICAL RÉGIME

The menus are arranged from the following food lists:

*Group I.* These foods are bland and include cooked refined cereal farina, strained oatmeal, cream of wheat, rice, cornstarch puddings, potatoes (mashed and baked), white bread, saltine or soda crackers (plain) butter and macaroni or spaghetti baked

with milk but without cheese or tomatoes. The beverages are milk, tea and coffee with cream.

*Group II.* One serving of meat daily, such as broiled lamb or veal chops, beef-steak, broiled or roast chicken, roast beef or lamb are included in this group. Water gravies are permitted if made from meat juices or bouillon cubes without fat. Non-oily fish, boiled or broiled may be substituted for the meat. No pork foods, spiced meats, mackerel or shell fish are permitted with this diet.

*Group III.* The following cooked vegetables are listed in this group: string beans, peas, spinach, carrots, beets, asparagus, winter squash, broccoli and cauliflower (if well tolerated by patient). Raw celery and lettuce apparently assist normal bowel function and are eaten daily. Mayonnaise is permitted as salad dressing. Citrus fruit juices (diluted with equal parts of hot water) are sipped slowly before breakfast.

*Group IV.* This last group includes all soups, cooked fruits, soft puddings, jello, light cakes, cream and cottage cheese, cocoa and food drinks. Sugar and salt are taken as desired but spices are omitted. Patients are warned to avoid cold food and drinks.

The supplementary régime is important. In instances of severe upset, the patient is given complete bed rest. At the start Group I or Groups I and II of the diet are prescribed. Tincture of bella donna is given one-half hour before meals in 10 drop amounts to relax bowel spasm. Phenobarbital is prescribed for very nervous individuals. Liquids are hot and in liberal amounts, a cup of hot water being given regularly every one or two hours. Heat is applied to the abdomen in the form of a hot water bottle at alternate hours. Usually these patients are relieved of their abdominal discomfort within a day or two. We avoid cathartics scrupulously and give enemas only when a stool has moved down into the rectum. An oil retention enema is given first, followed in twelve to twenty-four hours by a two to three pint saline enema,

if necessary. Patients frequently have spontaneous stools in three to five days on this regime. The full diet is then allowed.

#### LOW RESIDUE DIET

The low residue diet is essential in the proper preparation of the patient for elective, large bowel surgery. In addition, it has value in such conditions as diverticulosis of the colon when an attempt is being made to quiet a secondary inflammatory process without surgery and in the medical treatment of such things as regional enteritis and tuberculous enteritis. Merely grinding or chopping up meat, vegetables and fruits will not reduce their residue content greatly, though we have found this concept of a low residue diet to be held in some hospitals. It is quite possible to provide adequate amounts of the essential food elements in a fairly low residue diet. It is to be remembered of course, that merely the desquamated epithelial cells, mucus and bacterial masses in the bowel will produce an appreciable stool when the diet is residue free. Such is the chief composition of the so-called "milk stool," since 90 per cent of milk solids are digested and absorbed by most individuals.

A low residue diet should be selected from the following food lists:

*Group I.* These foods contain little residue and comprise the basic diet: farina, strained oatmeal, Ralston's Super-Farina, white bread or toast, soda crackers, macaroni, rice, baked or mashed potatoes. Butter, cottage or cream cheese, strained cream soups, clear broths and eggs (not fried) add some fat and protein to the diet. Custards, jello junket, plain cornstarch puddings and vanilla ice cream serve as desserts. Tea, coffee and cocoa contain no residue and may be taken freely.

*Group II.* These foods are higher in residue but contain important nutritional elements and, therefore, are permissible in some cases. They are chicken, white fish, tender meats (ground after cooking), pureed vegetables, strained fruit juices

(except when there is diarrhea) and pureed cooked fruits.

#### SAMPLE LOW RESIDUE DIET MENU

##### *Breakfast:*

Strained citrus fruit juice  
Cream of wheat, sugar, milk  
Soft boiled eggs  
White bread (toasted), butter, jelly  
Any beverage

##### *Dinner:*

Broth with saltines  
Finely ground tender meat, white fish or fowl (if more residue is permitted)  
Pureed vegetables, one serving  
Mashed potato, butter  
Gelatin with cream  
Any beverage

##### *Supper:*

Cream soup (vegetable flavor)  
Macaroni with cheese and tomato flavoring  
White bread and butter  
Cottage cheese and clear jelly  
Plain pudding or ice cream  
Any beverage

If it is believed that the patient's vitamin state is depleted before initiating this diet or that a sufficiency of the relatively higher residue elements as fruits, vegetables and meats should not be permitted, vitamin concentrates may be added.

Haliver oil capsules III, Brewer yeast tablets xv, and cevitic acid 200 mg. daily should suffice and represent fairly economical preparations.

The low residue diet frequently is low in iron. Iron citrate, one ampoule intramuscularly daily, may be given without altering the character of the stool.

In conjunction with the low residue diet we present an outline of the routine preparation for colonic resection as employed at the Massachusetts Memorial Hospitals. Such a régime works well. In most cases the bowel is empty and contracted at the time of operation and the patient is not significantly depleted by the process.

#### ROUTINE PREPARATION FOR COLONIC RESECTION

A. Beginning four to six days before operation the following régime is instituted and continued for 2 to 4 days: (1) 1 to 2 ounces of magnesium sulfate is diluted with 4 to 6 ounces of water and 1 ounce of this mixture given hourly by mouth starting at 7 A.M. (2) Cleansing soap suds enemas are given each evening. (3) The patient is urged to take extra fluids and extra glucose in form of rock candy. (4) The low residue diet for colon and rectal surgery is followed. (5) Parenteral fluids are administered in certain cases to compensate for excessive fluid loss from the bowel. Vitamin concentrates and iron citrate (intramuscularly) are indicated frequently.

B. Two days before operation the second phase of the régime is instituted: (1) The magnesium sulfate and enemas are omitted. (2) Two drams of paregoric are given three times a day by mouth to inhibit peristalsis. (3) The patient is given a transfusion as indicated. (4) A liter of 5 or 10 per cent glucose solution is infused intravenously each day.

#### DIET FOR POSTOPERATIVE STOMACH IN CASES OF UPPER SMALL BOWEL

It has been our practice to either leave a Levine tube in the stomach after gastric operations or to pass the tube periodically, starting six hours postoperatively. This prevents distention of the stomach with resulting strain on suture lines and gives the warning should hemorrhage into the stomach occur. It is also useful in determining when the stoma becomes patent and to what degree, i.e., presence of bile in the stomach, disappearance of foul-smelling stagnant gastric contents, usually present the first day or two after resection, and failure to recover all fluids taken by mouth. The diet is speeded up or withheld depending upon the magnitude of the stomach operation and the factor of stomal patency.

After gastric resection patients should plan to follow the postgastric diet indefinitely, with relatively small and frequent meals (five to six daily).

*Feeding Schedule. First day:* The patient is offered nothing by mouth. He may chew gum or suck on hard candy to promote salivary secretion, and may rinse out his mouth frequently. *Second day:* One dram of water at room temperature is taken half-hourly as desired unless the gastric aspirations show high degree of gastric retention. *Third or fourth days:* Water and clear liquids such as tea, plain malted milk, broth and ginger ale are given in 1 ounce amounts hourly, if the anastomosis appears to be opening. *Fourth or fifth days:* At this time 1 to 3 ounces of clear liquids, milk drinks, thin gruels and creamed soups are allowed each hour. *Sixth to tenth or twelfth day:* After the first week the diet is increased gradually, adding cooked cereals, soft eggs, custards, milk foods, plain crackers, butter, soft puddings, jelly, gelatin, baked potatoes and applesauce. Five to six small meals daily is the rule. After the twelfth day lean meats, pureed vegetables, stewed fruits, bread and potatoes may be added if the patient is doing well.

One may assume the existence of multiple vitamin deficiencies in many patients requiring gastric resection. We suggest, therefore, the following vitamin preparations to be administered along with intravenous infusions during the first few postoperative days: vitamin B<sub>1</sub>, 10 mg., nicotinic acid, 200 mg., cevitic acid, 200 mg.

When a stomach case has been on an inadequate diet for some time, crude liver extract given in 5 cc. doses intramuscularly each day is a valuable adjunct and probably exerts a hematopoietic action in addition to supplying essential vitamin B.

#### GASTROSTOMY FEEDINGS

Formulas for gastrostomy feedings are many and varied. Such a formula should have the following virtues: (1) Adequate

total caloric values, in particular sufficient protein and accessory food substances, (2) ease of preparation, (3) economy, (liver extracts and vitamin concentrate syrups are expensive), (4) minimal tendency to become sour or otherwise depreciate under ward conditions, and (5) sufficiently thin and smooth to run through feeding tube readily.

We believe that the simple formula given here satisfies these requirements fairly well. The caloric value is about 1.2 calories per cc. so that the total calories are sufficient for individuals leading the sedentary life of most gastrostomy patients. It is best to make up only a twelve or twenty-four hour supply at one time and to keep it on ice. It is wise to include the vitamins in at least twice the usual daily requirements, since most patients requiring gastrostomy have become badly depleted in this respect.

Pylorospasm resulting from the operative trauma to the stomach frequently causes regurgitation of the feedings. This may be obviated largely by passing the catheter through the pyloric ring into the duodenum at the time of operation and to be left in that location for a few days. In such case the milk should be peptonized.\*

The gastrostomy feeding finds its most frequent indication in cases of esophageal obstruction by neoplasm or stricture.

This formula will be found valuable also for nasal tube feeding of patients when indicated after mouth and neck operations, or for those unable to eat because of radiation reaction of these regions.

#### GASTROSTOMY FEEDINGS

The ingredients of the formula are:—30 ounces of boiled milk, 2 raw eggs, 2 ounces Karo syrup, and 2 Grams of salt. These are beaten up thoroughly. Feedings are administered every two hours during the day.

Gastrostomy patients usually will tolerate about 4 ounces per feeding at first. Later when pylorospasm subsides and the

\* Peptonizing tubes may be obtained from Fairchild Bros. and Foster, New York City.

stomach is stretched to its normal capacity the size of feedings may be increased to 8 ounces or more.

Sufficient vitamins in economical form are provided in the following mixture: orange juice, 4 ounces; codliver oil, 2 drams; Brewers yeast powder, 3 drams; to which is added 2 to 4 drams of 50 per cent solution of iron and ammonium citrate. This is given as a supplementary feeding daily.

The gastrostomy tube should be irrigated with water after feedings and changed occasionally.

#### JEJUNAL FEEDING

Jejunostomy for feeding purposes is accepted by many surgeons as a valuable and often life saving measure in surgery of the upper gastrointestinal tract. For example, certain cases of stomach resection with malfunctioning gastroenterostomy stomas may be tided over this difficult period with proteins, vitamins and other important food constituents given through a jejunostomy tube. Patients with an operable but obstructing neoplasm of cardia of stomach will gain considerable improvement in their general condition by such feedings prior to resection of the lesion.

The chief difficulty with jejunal feeding is that the jejunum was never intended to receive and digest food elements readily acceptable to the stomach. Abbott and Karr<sup>2</sup> in experiments with multiple ballooned intestinal tubes have shown that hypertonic glucose solution not only are irritating to the jejunum but that the bowel makes an effort to restore the isotonicity of the solution.

Some predigestion, at least peptonization of milk, is necessary in jejunal feedings if one is to avoid diarrhea. In such case the pabulum is not only not digested but additional body water and electrolytes are lost in the diarrhea. As a result of extensive studies on experimental animals and human patients Ivy and Scott<sup>3</sup> developed a system of jejunal feeding which they state can be used successfully in most cases. Wolfer<sup>4</sup> has

had equal success with a slightly modified version of their formula.

Ivy-Wolfer Formula <i>Jejunol</i>	
Water.....	2,000 cc.
Cane sugar.....	150 Gm.
Peptone powder.....	80 Gm.
Flour.....	120 Gm.
Milk.....	1,500 Gm.
Cream (20%).....	500 Gm.
Salt.....	16 Gm.
Total volume.....	4,000 cc.

Food Values	
Carbohydrates.....	335 Gm.
Proteins.....	153 Gm.
Fat.....	150 Gm.
This provides 0.84 calories per cc.	

*Directions for Preparation.* Sugar and peptone powder are dissolved in water and heated several minutes. The flour is made into a smooth paste with the milk and brought to boil. The two mixtures are combined and stirred vigorously at sub-boiling temperature until thickening occurs. The formula is strained and then stored on ice to prevent further digestion or fermentation.

Supplementary vitamin feedings (daily) include: orange juice,  $\frac{1}{2}$  cup, 1 egg, Viosterol, 3 drops, Haliver oil, 5 drops, Harris yeast, 1 tablet. These vitamin feedings while probably sufficient to maintain animals in good health would seem inadequate for human patients already in a depleted vitamin state, particularly in regard to the vitamin B content of the yeast. The pabulum would be improved nutritionally by more animal protein such as more eggs and gelatin. We would suggest that this formula be made up in half-quantity, i.e., total of 2,000 cc. which is about the limit the average patient will tolerate as jejunostomy feedings during a twenty-four-hour period.

Wolfer recommends a constant pressure pump for delivering the pabulum through the jejunostomy. This apparently is an improvement over the "gravity drip" method which is never constant due to the viscosity of the pabulum.

To avoid diarrhea he advises intermittent administration of the pabulum at first: 50 cc. of diluted pabulum during a twenty-

minute period each hour. The concentration and amounts of the feedings are increased as tolerated.

A more simple formula such as that recommended by Clute and Bell<sup>5</sup> has been moderately satisfactory in our hands.

Clute-Bell Jejunostomy Formula

- 1 pint skimmed milk (peptonized)
- 1 egg
- 6 mg. thiamin chloride
- 1 teaspoonful of vitamin B complex syrup
- 300 mg. cevitic acid
- 3 drops Haliver oil with viosterol

This pabulum has a caloric value of approximate 400 calories which is equivalent to 0.8 calories per cc.

The formula may have to be diluted with an equal quantity of normal saline to prevent diarrhea in some cases. Even this may be too irritating to the jejunum and isotonic saline and glucose only may have to be substituted. Paregoric and at times bile salts, or the aspirated gastric juices added to the formula help to control the diarrhea.

#### SIPPY DIET

Medical management of peptic ulcer lies principally in diet. Unquestionably this should be largely the responsibility of the internist. Surgeons, however, should be intimately acquainted with the composition of ulcer dietary régimes, the most generally satisfactory of which is the Sippy diet. The Sippy diet probably has sustained more modifications than any other. Best results are obtained by fairly close adherence to Sippy's original régime.<sup>6</sup> Patients with active peptic ulcers should have bed rest, preferably in the hospital, during at least the first two weeks of the scheduled régime (though Sippy advised six weeks). Tobacco and alcohol should be omitted entirely. The presence of concomitant diseases, such as chronic cholecystitis which may interfere with the healing of an ulcer, should be excluded by appropriate studies.

The Sippy diet does not contain enough ascorbic acid (vitamin c). Recent studies appear to indicate that ulcers heal faster when this vitamin is added in liberal doses.

Sippy's insistence on adequate neutralization of the excessive free acidity of the gastric juice in patients with ulcers is just as valid today as when he first proposed it. Some patients, however, develop an alkalosis on the relatively large amounts of alkaline powders necessary to neutralize their acidity. Magnesium hydroxide, marketed under several proprietary names, frequently will accomplish the neutralization without disturbing the body electrolyte balance.

Recurrences of peptic ulcer are best avoided by recognition of the truth of the axiom, "once an ulcer patient, always an ulcer patient." We believe that a Post-Sippy régime as listed here should be adhered to indefinitely. Such a diet, with its frequent bland meals is useful also as a convalescent diet following gastric surgery.

#### SIPPY DIET (FOR PEPTIC ULCER)

For the first three weeks the patient receives 3 ounces of equal parts of milk and 20 per cent cream every hour beginning at 7 A.M. for twelve feedings. A dram of ant-acid powder or 2 drams of amphojel are administered each hour on the half hour: 7:30 A.M. to 10:30 P.M.

Besides the milk and cream mixture, additional feedings are given according to the following schedule: First day no additional feeding; second day add one soft egg at 10 A.M.; third day add cream of wheat at 4 P.M., fourth day add one egg at 6 P.M., fifth day add cream of wheat at 8 A.M., sixth day add one egg at 2 P.M. Four to six ounces of orange juice or 100 mg. of cevitic acid are given daily.

White bread toasted, toasted white crackers, jelly, cream cheese, custards (no nutmeg), junket, may be added on the seventh day. On the seventh day, therefore, the patient will be getting six feedings in addition to his regular milk and cream.

If everything goes well during the second and third weeks, the patient has three small meals a day (not over 9 ounces per meal) from the Post-Sippy diet, at 8:00 A.M., 12:00 and 5:00 P.M. The milk and

cream feedings are continued hourly from 7 A.M. to 7 P.M. except at meal time.

#### MEDICATION

Ant-acid medication is adapted to the individual case. The powders most frequently used are:

Sippy powder No. 1 or A which contains magnesium oxide, grains x; sodium bicarbonate, grains x.

One dram is given three times a day until the bowels are open, and then only as needed for regularity.

Sippy powder No. 2 or B which contains calcium carbonate, grains x; sodium bicarbonate grains xxx.

This powder is given for acidity in  $\frac{1}{2}$  to 1 dram amounts hourly on the half hour.

One or 2 drams of amphojel hourly may be substituted for the powders in some patients, although this preparation seems less effective in acid neutralization.

#### POST-SIPPY DIET

The patient starts on this régime after three weeks of the Sippy diet and continues it indefinitely. There are three meals daily with milk and cream between meals and at night.

A Sippy powder or amphogel usually is taken after meals or as needed at other times.

*Food Lists (Same for Post-gastric Diet).* This list includes bland cereals, such as cream of wheat or Ralston's Super-Farina, soft eggs (boiled, poached, baked or scrambled in cream in top of double boiler), white bread and butter, toast, white crackers, spaghetti, macaroni, creamed or with cheese, American, cream or cottage cheese and cream soups.

Chicken, tender beef, lamb and fish are allowed but no mackerel, clams, scallops or salmon and no fried fish. Pureed vegetables and baked, mashed, creamed or riced potatoes and cooked soft fruits without seeds or fiber are included.

The desserts include whipped cream, sponge cake, angel cake, soft puddings and frozen desserts without fruits or nuts, jellies, junkets, and cornstarch puddings. Strained orange juice (4 ounces) is taken once daily during or after a meal.

The beverages allowed are tea, cocoa and coffee, the latter sparingly.

The daily diet should include at least one serving of meat (or fish or poultry), one egg, one or two servings of pureed vegetables and one serving of fruit besides orange juice.

A number of foods should not be included in the Post-Sippy diet, i.e., salads, fried foods or pastries, hot breads or muffins, bran, buttermilk, raw fruits, candies, nuts, ginger ale or other tonics, green corn, tomatoes, turnip and cabbage.

Patients with peptic ulcer should be urged to avoid smoking and alcohol.

#### ANDRÉSON DIET

For patients with ulcer who do not tolerate the relatively heavy milk-cream mixtures of 'the Sippy diet well, Andréson' recommends a special régime. In this, alternate feedings of gelatin-milk and meat broth mixtures are used. The former mixture we have used with good results in cases with bleeding ulcer following the recommendation of Andréson. The gelatin appears to be particularly efficacious in neutralizing the excess acid, while the glucose, milk and cream provide, in addition, needed calories to these patients. Vitamins, particularly vitamin K, are administered liberally by the parenteral route.

#### ANDRÉSON'S ULCER DIET

Gelatin-milk Mixture	
Gelatin (powdered).....	30 Gm.
Glucose.....	60 Gm.
Cream (20%).....	100 cc.
Milk.....	900 cc.

1,000 cc. 1,000 calories

The food values are 99 Gm. carbohydrate, 57 Gm. protein, 45 Gm. fat.

It is wise to add 100 mg. of cevitic acid or 4 to 6 ounces of orange juice twice daily. This diet is very satisfactory following hemorrhage from peptic ulcer. Two to four-ounce feedings are started immediately and given one to two hours.

We have adopted a constructive régime in the handling of patients with serious

bleeding ulcers on the ward service at Massachusetts Memorial Hospitals. A massive transfusion, the blood being given by the constant drip method, is started as soon as possible. As much as 2 liters or more of blood may be given in twenty-four hours. The Andr son gelatin-milk mixture is started at the same time and the diet rapidly broadened following the Meulengracht principle. Of six patients so treated recently five had no further serious bleeding. The red blood cell count rose in twenty-four to forty-eight hours to satisfactory limits; the course was uneventful from then on. The sixth patient had some recurrent bleeding though slight, and died of pneumonia two weeks later. Should there be evidence of continued serious bleeding despite this r gime, operation may be performed at the end of twenty-four hours or less, when the patient is in better condition because of the massive transfusion and other supportive measures.

#### MEULENGRACHT DIET

The Meulengracht diet has received much notice recently, mostly favorable, in the management of bleeding peptic ulcer. The morbidity and mortality of this condition are certainly lower when this diet is used than with the old starvation r gime. We believe that the efficacy of the Meulengracht diet is due to three principal factors: (1) the supplying of necessary food elements, particularly proteins and vitamins to depleted patients, (2) improvement in tone of stomach musculature due to restoration of normal function and (3) neutralization of excess acid by natural foods. There is no magic other than that. The Meulengracht diet is not presented in detail here. In composition it is quite similar to the Post-Sippy diet, except for the routine milk and cream feedings. The foods are given in liberal quantities and at carefully scheduled intervals. We believe that this diet is valuable in patient's with serious but not critically bleeding ulcers. When the patient is critically ill, nearly comatose from severe hemorrhage, we favor the lighter Andr son

gelatin-milk mixture as an adjunct to massive transfusion, followed by operation in selected cases.

#### LOW FAT DIET

The low fat diet is useful in cases of gall-bladder disease. Although patients with gallstones have less indigestion and fewer attacks of colic when adhering closely to such a diet, it is no guarantee against future attacks. There is little likelihood also of the diet's being instrumental in dissolution of gallstones. From the surgeon's point of view such a diet is well suited to a patient who is recovering from an acute cholecystitis (should delayed operation be decided upon). After cholecystectomy, also, some patients do better if the fat content of their diet is restricted. Jaundiced patients or others in whom the supply of bile is deficient in either quality or quantity should be given a low fat diet.

Ravdin<sup>8</sup> states that depletion of protein storage in the liver is an even more significant factor in liver insufficiency than is glycogen depletion. He has suggested casein as an adequate, readily available protein and advises its use in the form of chocolate flavored drinks to supplement the proteins of regular meals.

Skimmed milk as a natural source of casein is a more palatable protein food and simpler to prepare than the powdered casein. Cottage cheese also is practically pure milk protein except for an average of 10 per cent fat content.

#### DIET LIST

The foods to use include all cereals, except bran or bran flakes, white or dark bread, crackers, potatoes, rice, macaroni and spaghetti. Fruits, both cooked and raw, fruit juices and most vegetables should be taken liberally. Cream soups if desired (made with skimmed milk and without butter) may also be taken.

Protein is provided in the form of lean meat, fish or chicken served once daily. These should be roasted, broiled or boiled.

Meat sauce or gravy made from bouillon cubes contains almost no fat.

Three or more glasses of skimmed milk should be taken daily and may be made into cocoa.

Desserts include jelly, marmalade, jam, honey, maple syrup, sugar candy drops, mints, puddings and gelatins made without butter, cream, egg yolk or chocolate.

A number of fatty foods should be avoided, *i.e.*, cream, oil, cheese, except cottage cheese, butter, eggs, meats high in fat, such as pork, lamb chop, bacon, ham, goose, oily fish, liver, kidney and meat broths.

Salad dressing, except when made with mineral oil and with very little seasoning, nuts, bran muffins and bran bread should be avoided.

*Sample menu:* Carbohydrates 320 Gm. proteins 90 Gm., fat 25 Gm., calories 1,865.

#### *Breakfast:*

Large glass of grapefruit juice  
Cereal with sugar and milk  
Two slices toast—jelly  
Glass of skimmed milk  
One cup weak coffee or tea, if desired

#### *Dinner:*

Lean hamburger, broiled  
Baked potato  
Peas  
One slice bread—jelly  
Fruited jello  
Glass of skimmed milk

#### *Lunch or supper:*

Asparagus on toast  
Cottage cheese  
One slice bread—honey  
Applesauce  
Glass of skimmed milk

To increase the carbohydrate and protein of this diet, still keeping the fat low (as indicated in cirrhosis, cholecystitis, pancreatitis and associated conditions) two servings of cereals, bread, potatoes, sugars, fruits, meat, fish or poultry should be given

daily. Skimmed milk should be increased to four to six glasses daily. Cottage cheese should be added to the diet. This may be combined with fruits in salads.

#### REDUCING DIET

Not infrequently the surgeon will advise an obese patient to lose twenty, thirty or fifty pounds before he will undertake the repair of a large hernia. This is a difficult feat for such patients. They enjoy eating particularly rich foods.

A reducing diet such as presented here will be palatable and stomach filling, if not completely satisfying to them. Unless the patient is unusually sedentary he should lose about one to three pounds a week on such a régime. Three pounds a week is the reasonable limit of weight loss if strength is to be maintained. The caloric content of this diet may have to be reduced to 1,000 or even 800 calories daily at times to attain desired weight loss.

#### REDUCING DIET (1,200 CALORIES)

##### *Breakfast:*

- 1 Serving fresh fruit (not pears, grapes or banana)
- 1 Egg (not fried)
- 1 Slice of bread or toast
- 1 Level teaspoon butter
- Coffee or tea with milk (no sugar)

##### *Dinner:*

- 1 Serving of lean meat, fish, or chicken (not fried)
- 2 Servings 5 per cent vegetables or 1 serving 10 per cent vegetables
- 1 Medium-sized potato or 1 slice of bread
- 1 Level teaspoon butter
- Fruit as for breakfast
- Tea or coffee as at breakfast

##### *Supper:*

- 1 Serving lean meat, fish, chicken, or 2 eggs
- 1 Glass milk or buttermilk
- 2 Soda crackers

2 servings 5 per cent vegetables or 1 serving 10 per cent vegetables  
 Fruit as for breakfast  
 Leafy vegetables are especially good  
 Clear broth with fat removed, and lettuce may be eaten as desired  
*No sugar; no extras*

Five per cent carbohydrate vegetables include: cucumbers, spinach, asparagus, lettuce, sauerkraut, beet greens, dandelions, Swisschard, celery, mushrooms, tomatoes, Brussels sprouts, cauliflower, eggplant, cabbage, radishes, string beans and broccoli.  
 Ten per cent carbohydrate vegetables include, turnip, squash, beets, carrots, onions and peas.

#### SUMMARY

The subject of dietary régimes in surgery is one often passed over too lightly by surgeons. A compilation of the diets more commonly used on the general surgical service of the Massachusetts Memorial Hospitals, Boston, is presented. In discuss-

ing these diets an effort has been made to emphasize practical aspects. It is suggested that mimeographed copies of surgical diets for distribution to patients may prove useful.

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# FUNDAMENTALS IN GASTROINTESTINAL SURGICAL TECHNIC\*

## OBSERVATIONS IN THE EXPERIMENTAL SURGICAL LABORATORY

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**D**URING the course of several hundred gastric and intestinal anastomoses in animals, several facts and principles of safe operative procedures were repeatedly brought home to us. None are new. However, their emphasis may bear repetition.

Intestinal suturing in the dog is somewhat different than in man. The bowel musculature is heavier, the wall is stiffer and the lumen is smaller. Hence it is not as pliable and if inverted too much, there will be a diaphragm obstructing the lumen. The serosa tears more easily. The dog does not stand peritoneal contamination as well as man does. It is well known that gastrointestinal anastomosis has a higher mortality in dogs than in humans because of these facts.<sup>1</sup> Nevertheless, many of the lessons learned in the animal surgical laboratory are directly applicable to the major hospital operating room.

The operations we were interested in were chiefly Mann Williamson "surgical duodenal drainage," in which a gastrojejunum anastomosis was done, and another anastomosis made between the jejunum and ileum. Gastric pouches, total gastrectomy, and other intestinal procedures were also done. Nembutal intraperitoneal anesthesia was used. Silk was used throughout. The anastomosis was usually done without clamps, using the open method with one inner, one outer layer of sutures.

### INTESTINAL SUTURING

It took us a long time to learn that the most important principle in a successful anastomosis was the adequacy of the blood supply. In lateral anastomoses, the arterial

supply is sufficient but with end-to-end anastomoses, the bowel is very liable to necrosis of the distal end, especially on the antimesenteric border. Time and again there was softening here, with leakage through the softened area, and when we analyzed the cause we finally thought it was because the bowel was too tightly infolded, or the mesenteric border had been isolated too far from its blood supply. The lower end of the esophagus has a poor blood supply. In leakage after esophagojejunal anastomosis, the jejunum, in many cases, will be surprisingly fresh looking, but a wide area of the esophagus is necrotic, almost semiliquid. This can only come from interference with the blood supply rather than poor apposition of the walls of the gut.

One need only approximate the serosal layers of the gut very loosely. Autopsies done on dogs twelve or twenty-four hours after intestinal suturing show a firm fibrin layer sealing over the suture line, so that the threads are scarcely visible; and this exudate is already firm in twenty-four hours.\* (Fig. 1.) It is not necessary to do any more than hold the two surfaces together until this fibrin formation takes place.

The next most frequent cause of leakage, we thought, was tying knots too tightly. Local tissue necrosis develops, there is a

\* "After one-half hour a deposit of fibrin occurs due to clotting of blood plasma . . . Even the most delicate suturing would not prevent leakage and subsequent peritonitis were it not for this astounding ability of the serous coats to seal itself so rapidly and completely."<sup>3</sup> "Within a few hours after the abdomen is closed, a layer of fibrin forms at the site of anastomosis, constituting an effective barrier against leakage."<sup>4</sup>

\* From the Laboratory for Experimental Surgery, Harper Hospital. Aided by a grant from the Mendelson Fund.

break in the serosa, with a locus minoris resistancia down to the submucosa and then the mucosa. (Fig. 2.) A lightly placed (which everyone passes through serosa and muscularis only) is passed directly through all the layers of the bowel into the lumen,



FIG. 1.



FIG. 2.

FIG. 1. Fibrin layer completely covering and obscuring intestinal sutures twenty-four hours after operation.

FIG. 2. Outer layer sutures tied too tightly, and cutting through.

tacking suture, passed through the serosa and a portion of the muscularis, if tied tightly will cut through and leave just the area one wished to protect, minus its natural serosal safety layer.\* Time and again we have seen fatal peritonitis from such a light stitch. Often this was a stitch placed at a corner of the anastomosis, for "extra assurance." The peritonitis followed one small puncture hole at this site, the rest of the anastomosis being entirely healed. On the other hand, if the outer layer suture

\* "It has been said that more deaths will occur from the leakage of the suture that does not catch the submucosa than from any sepsis that might follow penetrating the mucosa."<sup>2</sup>

but it is kept loose so that the gut wall is not constricted, it is entirely safe, at least in the dog. No leakages followed this method, especially if a small needle was used. We finally tied the knots so that we could always see a bit of thread between the two surfaces. If the bowel wall blanched, indicating the slightest ischemia, the suture was cut and passed again.

A visit to almost any operating room will show intestinal sutures tied too tightly. The parts swell perhaps one-third within a few hours. All one can do is hold them together, as above noted, and provided there is no tension on the parts sutured, this is neces-

sary only for several hours. The inner layer must be snug enough to control hemostasis, especially posteriorly; but the outer serosal

jejunal) or lower (jejuno-ileal) anastomosis. The leaks were all on the anterior surface, and in at least 60 per cent of the cases at

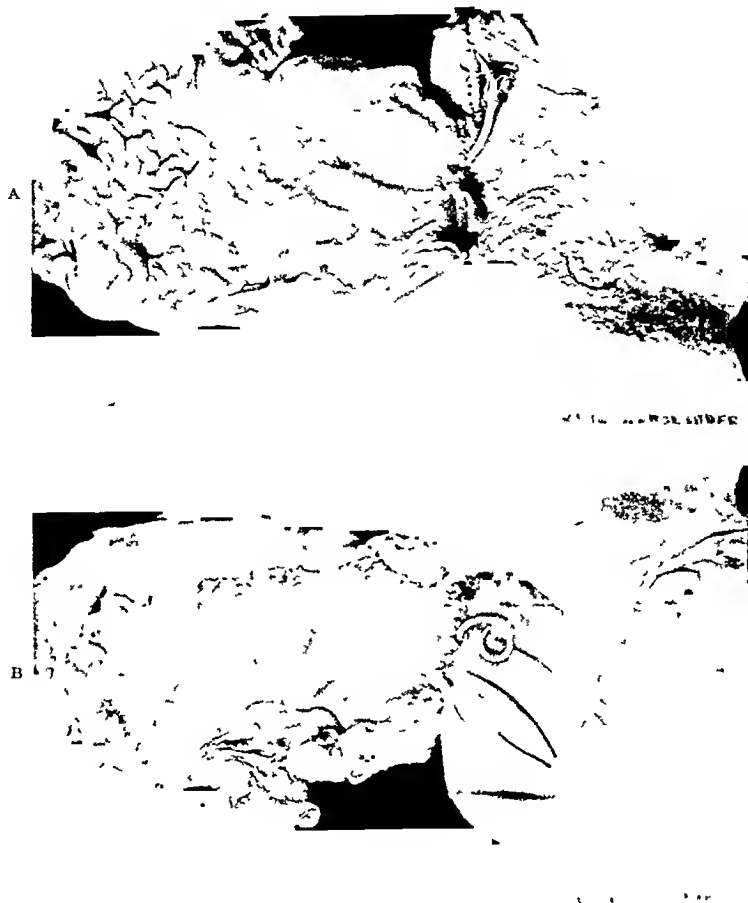


FIG. 3. Round worm wriggling through anastomosis; (A) lumen (mucosa); (B) serosa.

layer must never be tight. This is more important than the type of suture (Connell, Halstead, Cushing, etc.) whether interrupted or running stitch, or whether two or three layers are used.

Of course, the bowel must be well approximated. On three occasions, we have autopsied dogs and found a round worm (dogs frequently are infected with round worms two or three inches long in the upper jejunum) half way through the anastomosis, having wriggled through the suture line. (Fig. 3.)

We have never had a leakage on the posterior layer, either the upper (gastro-

the angles. This is the potential weak spot. Leaks at these angles are not eliminated by adding other sutures which infold more of the bowel. The secret is obtaining a smooth, well approximated suture line in the first place. This means the mucosa turned in neatly with the inner layer, and the outer layer sewed together like an expert dressmaker would do it; the two sides sized up so that no ruffles or teats are left. A longitudinal incision into the lumen of the bowel will gape more than a circular one. The reason is that the circular muscles are stronger; when these are cut, the bowel is flabby and loses its tension. When anastomosing end-

to-side, this must be gauged. If one side is longer than the other, the lengths must be adjusted neatly before one comes to the

toma underneath the serosa. Once a fatal perforation of the bowel wall ensued from an Allis clamp applied fully  $1\frac{1}{2}$  inches



FIG. 4. Tears in undersurface of liver from the "digging in" of a retractor.

angle and the end of the stitch. This accomplished, additional basting stitches at the sides, or ends are superfluous and they are even dangerous. We do not believe that tacking omentum over a poor anastomosis helped a great deal. At least this is so in our experience, for, as above stated, leakage has occurred through such lightly passed additional sutures, when the entire anastomosis was otherwise good. The same holds true for a difficult anastomosis such as the end of the esophagus to the jejunum. Two well placed, "tailor made" suture layers, accurately holding the two cut surfaces together, with no hump up at either end, and a good margin of serosa infolded without tension, will hold. (We have often considered that only one layer of sutures with a wide peritoneal apposition was sufficient but have routinely applied two layers.) No amount of care in patching up weak areas or pouting angles or "teats" in the suture line will be half so secure.

If, during the operation, a divided end of bowel was to be held aside for a few minutes, we were in the habit of putting a moist sponge over it and securing it with an Allis clamp. This often left a "sandboil," a swollen, dull reddish blister where the clamp had been, which denoted a hema-

away from the anastomosis. We never boiled this instrument up again. Stephenson and Reid<sup>5</sup> caution against ring clamps used on the bowel; they cause minute hemorrhages in the mucosa "even though the serosa appears to be undamaged."

In dogs, we have never seen a leak of the duodenal stump. The anatomy of the dog is different at this point. The duodenum is held on a loose mesentery and is not tightly bound down to the posterior peritoneum. The muscular layer separates away from the mucosa so that the mucosa can be inverted. The serosa and muscularis can then be closed over with a few sutures in a firm union. The dog's intestine is thicker and more rigid, and the mesentery is looser and thinner than in man. Several times we have seen peritonitis develop several days after operation which we thought due to the following sequence of events: twisting about the root of the mesentery or about a fibrous adhesive band; circulatory occlusion, gangrene of the bowel segment, necrosis, then perforation. One must be much more careful in replacing the anastomosed bowel in the dog's abdomen, and in avoiding any undue twisting of the loops. Rough handling and tension which may produce later adhesions are also at a premium.

It is well known that the peritoneum will stand for a certain amount of soiling, but will not stand for gross contamination or continued leakage. Bergh Bowers and Wangenstein<sup>6</sup> showed that if peritonitis was produced by a simple stab into the stomach, it was two or three times as lethal if the stomach was full, as when the dog had been fasting. Our experience bore this out; the chance of peritonitis was much increased if, for some reason, the dog had not been fasting. Whenever there was liquid contents in the small bowel, and the technic was not careful enough to prevent leakage into the peritoneal cavity, we expected fatal peritonitis. With fluid contents, if we were very careful to avoid spillage and contamination, we did not get peritonitis.

With these precautions we have not used sulfanilamide routinely in the peritoneum. Recently Varco<sup>1</sup> of Wangenstein's clinic reported that sulfanilamide crystals sprinkled about the anastomosis obviated the danger of leakage. He performed thirty-seven complicated gastrointestinal anastomoses without a death. "In animals dying during the first twenty-four hours of generalized peritonitis there is little fibrin sealing the anastomotic sites, and the stitch holes themselves leak contamination." Sulfanilamide by keeping down this infection, allowed the fibrin layer to form quickly.

#### ASSISTANCE

It is a fundamental that the first assistant is responsible for the exposure. In doing an intestinal anastomosis, the parts are usually well exposed on the surface of the wound, and one might think exposure *per se* was no problem. But consider how the following may facilitate the actual operating: There are fresh drapes to be adjusted. Each motion is in a contaminated field; sponging should be with the tip of a small moist sponge, done frequently enough to keep the lumen clean, but with not one unnecessary wipe. In passing sutures, if the assistant holds the bowel to the right of the

surgeon's right hand, there will be a little tautness, so that in passing the needle, there is a fixed point to pull against, which makes suturing easier. When passing the needle in certain directions (using a straight intestinal needle), the operator easily picks it up when the point emerges through the bowel wall; but in others, the assistant helps by being ready to grasp the needle as it emerges with the same motion as when it went in. After completing the posterior layer, and changing to the in-out-and-over stitch of the anterior layer, assistance is best given by changing the hold on the bowel, and elevating it by the guide sutures at both ends. As the assistant follows the suture, he may shift the thread from one hand to the other, depending upon which angle is more out of the way for the operator. At certain steps in the operation if the assistant's hands are in better position, he may do the operating while the surgeon assists. Examples in human surgery are: In a gastric resection coming down from the lesser curvature to the greater with the final outer serosal Lembert layer, the surgeon's right hand is in an awkward position to pass this stitch high up under the left costal margin. In a hysterectomy, the clamps (and also the sutures) on the left side of the uterus are much easier to place from that side.

An assistant, in his earlier training, will be more concerned with tying sutures, reaching for the scissors to cut after the knot is tied, glancing at the instrument table and following the surgeon's movements, without any purpose in view. He may be intensely interested in all the maneuvers, but it is the wrapt absorption of the bystander watching the firemen at a third alarm fire. His hands placed in one certain position, there they stay, without sensing that the operation has proceeded and a new position is now necessary, or that something else can be done which is now more desirable.

The above directions and statements sound simple but practical efficiency takes years of experience. Dr. Max Ballin always

said that it took three years to train the intern's hand in the operating room. It is more than hand training. It presupposes a thorough knowledge of what the next move is to be, as in reading music the eye must be three or four bars ahead of what the hands are playing. An assistant is much better after he has had the opportunity of doing the operation himself a few times. In our experience, we have seen only one chap acquire this ability to anticipate and facilitate the surgeon's movements without long training. Some, we believe, never learn it.

The "heavy handed" retractor is occasionally mentioned in various surgical articles. Pulling on the abdominal wall stretches the abdominal fascia, causes hemorrhage in the muscles, and is one cause of postoperative pain and distention. The liver especially does not like the protracted digging in of a firm metal plate. Some surgeons use a Deaver retractor with a soft spring blade so that undue pressure on the undersurface of the liver does not occur. The dog's liver is softer than that of the human. Figure 4 shows the tears made in it by an ordinary Richardson retractor. At autopsy next day there was 200 cc. of blood in the peritoneal cavity. This may not be directly applicable to retraction in the operating room, but the lesson is there.

#### SUMMARY

1. Although the dog's intestine is thicker and less resilient than that of man, much that can be learned about intestinal suturing in the experimental surgical laboratory is directly applicable to the major operating room.

2. The chief causes of unsuccessful suturing are: (a) Inadequate blood supply; (b) tying sutures too tightly and causing local tissue strangulation; (c) not approximating the anastomosis carefully, and (d) gross soiling of the peritoneal cavity with intestinal contents, especially if there was no preliminary fasting.

3. The function of the assistant is discussed, chiefly as regards exposure, the faculty of anticipating the next step in the operation and retraction.

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# ANESTHESIA DURING SUBTOTAL GASTRECTOMY\*

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AMONG the many recent advances in anesthesiology none has more significance than the increasing realization that anesthetic drugs and methods must be adjusted to the patient rather than the operation. The title of this discussion is therefore misleading since it suggests the opposite of this tenet. It will be the purpose, however, to emphasize the individualization of the anesthetic procedure for each patient, while describing the technics that have been employed to treat seventy-five consecutive patients subjected to subtotal gastrectomy. The anesthetic régime is not described with the idea of suggesting that it is the more desirable for all patients having subtotal gastrectomy nor is it claimed that it is better than other methods. There is the full realization that an all too common error is an attempt of surgeons and anesthesiologists to "standardize" an anesthetic procedure for a given operation. Any argument in favor of a "best" method cannot be convincing unless the many variable factors attending surgery and anesthesia are evaluated. If all anesthesia and surgery were done with the same degree of skill and judgment, if the number of cases with different methods were large enough to have statistical value, some logical comparison might be effected. Here, it will suffice to defend the method presented by pointing out that the surgeon was entirely satisfied and unhampered during his manipulations, and to add morbidity and mortality data to emphasize the results for the patients. It should be stated that the large majority of these anesthetics were not

administered by specialists but by a succession of residents in a training school for anesthesia. The surgery was done by one of us (J. W. H.).<sup>1</sup>

In the consideration of the anesthetic régime for any surgical procedure two major factors of the problem must be appreciated and surmounted successfully: First, the surgeon must be given adequate facility to perform the operation planned. This is apparent of course, since otherwise there is no reason for propounding the anesthesia. The second consideration—and it must be considered as imperative as the first—lies in the fact that the anesthetic procedure must be carried out with a minimum of discomfort and the maximum degree of safety to the patient. These two general factors form the basis of any decision concerning the selection and management of an anesthesia designed to permit surgery on the stomach.

The first step in the management of the patients cited in this series of cases has been a consideration of the drugs used for preanesthetic medication. Individualized doses of morphine combined with scopolamine have proved satisfactory. The amount of morphine has varied with several factors: the age, sex, weight, metabolic activity of the patient, and the anesthetic agent used. Patients in the upper age groups, as well as those with low metabolic rates usually received smaller than average doses of morphine. A choice of cyclopropane often has permitted the use of smaller doses of morphine than if ether were the agent used, due to the

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degree of respiratory depression seen when the former drug is employed. Occasional patients received morphine 0.015 Gm., the majority received 0.01 Gm., while a number of patients in older age groups or those in which cyclopropane was the agent of choice, received 0.008 Gm. The dosage of scopolamine ordinarily was kept at a ratio of 25:1 with the morphine, though occasionally it was raised beyond this ratio. The advantages of morphine including its sedative effect, and particularly its depression of metabolism, have been thoroughly studied.<sup>2</sup> The use of scopolamine to counteract the decreased pulmonary ventilation from the effect of morphine as well as for its tranquillizing cerebral sedation has also been scientifically evaluated.<sup>3</sup> It has been found that scopolamine in a ratio with morphine of 25:1, ordinarily counters the respiratory depression of morphine almost exactly, and leaves the patient with a desirable "don't care feeling." Waters has found that the optimum time of administration of these drugs is an hour to an hour and one-half before the induction when given subcutaneously since this permits maximum effects to be reached by that time. While these premedicant drugs are ordinarily given subcutaneously, if for any reason it is desirable that their administration be delayed, they may be given intravenously immediately before the anesthesia is started. This route of administration may be used safely and frequently more conveniently than the subcutaneous method.

Inhalation methods have been employed exclusively with satisfactory results so far as the surgical requirements were concerned. The surgeon was permitted to perform the required operative procedures readily. With either cyclopropane or ether any degree of muscular relaxation may be obtained quickly. With the procedure employed the psychic and sensory discomfort of the patients has been disposed of satisfactorily.

The to-and-fro carbon dioxide absorption technic has been the method of choice. An

endotracheal airway was used for most patients. It is held desirable that an endotracheal tube with an inflatable cuff be used in this as in all surgery of the stomach. By this means such gastric contents as are occasionally expressed into the pharynx may be removed easily with suction, while at the same time they are prevented from entering the trachea. The use of an endotracheal airway eliminates the fear of respiratory obstruction and permits the use of technics for controlled respiration whenever desired.<sup>4</sup> Among the several advantages of controlled respiration, are conservation of patients' energy, the effortless respiratory movements of the abdomen offered for the convenience of the surgeon, and the fact that in deep anesthesia, the pulmonary content of oxygen is raised. The completely free airway supplied by an endotracheal tube is also of the greatest importance in the efficient maintenance of the oxygen-carbon dioxide balance throughout the entire procedure. In addition, the means for artificial respiration are thereby readily available in case of need, particularly upon the appearance of shock.

Perhaps the most important single factor in the use of the carbon dioxide absorption method is the dosimetric control and flexibility which it offers to the anesthetist. A measured amount of oxygen to meet the individual metabolic requirements, while the carbon dioxide is removed, helps to maintain normal physiological requirements. The anesthetic agent used may be added or removed as the requirements of the surgery or the condition of the patient indicate. In addition, the warm and humid atmosphere which the patient breathes is of undoubted importance in the prevention of postoperative respiratory complications.

A discussion of anesthetic agents used includes the alternatives of cyclopropane and ether. These two agents have been used in accordance with their indications and contraindications. Otherwise when a free choice was presented, the personal preference of the anesthetist and surgeon in most instances was the deciding factor. In

most cases, there was little to recommend one agent over the other. In this clinic it has become an increasingly prevalent practice to switch from one agent to the other with no hesitation. If a persistent arrhythmia has been present, which may be due to an increase of irritability of the cardiac musculature from cyclopropane, the change to ether was prompt. Lower bronchial constriction, brought about by the parasympathomimetic action of cyclopropane on the bronchoconstrictor fibers of the vagus has occurred but rarely. In these cases a change to ether has resulted in immediate relief of the symptoms of lower bronchial obstruction.<sup>5</sup>

More frequently, when ether was the agent initially used, a change to cyclopropane has been made. This has been the case most often during the more difficult steps of the surgery, when maximum relaxation and quietness of the abdomen and contents has been required, and of course, when the peritoneum was being closed. The parasympathomimetic action of cyclopropane has been taken advantage of to bring about constriction of the gut in those instances in which its distention proved to be an annoyance to the surgeon.<sup>6</sup> The effortless type of respiration seen in deep cyclopropane anesthesia, and at times, the complete quiet offered by the controlled respiration techniques, have made such a change to cyclopropane highly desirable in many cases in which ether was the original elective agent.

At the time of completion of the operation, the patients have had much of the anesthetic agent "washed out." It is essential that this be carefully done in order that a complete return of reflexes may be had soon after operation. Before removal of the endotracheal tube at the end of the operative and anesthetic procedure, a careful tracheal toilet is performed. Any mucus lying in the pharynx is removed with suction before release of the inflatable cuff on the airway. A small catheter attached to the suction tube is inserted in the endotracheal tube, and any mucus in the trachea and primary bronchi thus removed.

The cuff is then released and the endotracheal tube removed.

There are other factors adjunctive to the details of the anesthetic management of these cases, which are of equal importance.<sup>7</sup> These include the most meticulous preparation of the patient preoperatively, with due regard to his fluid balance, and the administration if in any degree indicated, of a blood transfusion. Practically all patients have been brought to the operating room receiving an intravenous infusion of glucose in saline. During operation, following the earliest appearance of any degree of circulatory depression, a blood transfusion has been substituted for the infusion. Postoperatively, the usual care has been taken with all patients, which includes careful administration of fluids as indicated, movement of the patient and proper administration of oxygen. The use of hypnotics and sedatives has been rigidly minimized.

It is a matter of the greatest importance that insofar as possible the individual physiological requirements of this group of patients were met. While the anesthetic was prolonged to permit surgery for extended periods of time in which marked relaxation was not required, the patient was maintained in relatively light planes of anesthesia. Since deep anesthesia in itself may be a factor in the production of shock, this method of management is indubitably of value. At all times throughout the entire proceeding, the patient was well oxygenated, since in a closed system as described, the oxygen content of the inspired atmosphere was considerably more than the 20 per cent in air. The necessity of such a maintained oxygen level cannot be overemphasized. In such prolonged and sometimes shocking operations as these, any degree of anoxia coupled with or resultant from lowered arterial tension should be avoided.

These prophylactic and therapeutic measures taken to meet and combat the appearance of shock are of obvious significance. Perhaps the other major possibility of anesthetic complications lies in the

respiratory tract. There are many factors in the maintenance of a low level of incidence of such complications, particularly the use of endotracheal technics with an inflatable cuff to prevent aspiration of gastric contents, thorough "washing out" of the anesthetic agent at the end of the operation, and careful tracheal toilet before removal of the endotracheal tube.

There were seventy-five patients in this series on whom subtotal gastric resection was done for ulcer. Sixty-eight were males, and seven females, averaging 42.6 years of age. The primary anesthetic agent used was ether in sixty-two cases, and cyclopropane in thirteen. Endotracheal technic was used in sixty-six, while seven patients were anesthetized with simple absorption technic without intubation. For two patients with uncontrollable massive hemorrhage, abdominal field block and cyclopropane were used.

There were no serious operative complications nor was the indicated operation incomplete for any patient in this group. There were four deaths in this series of operations, only one of which may possibly have had anesthesia as a contributing factor. This was a death from pneumonia which developed postoperatively. The three other deaths were from peritonitis. The postoperative complications for the seventy-five patients which may be referable to the anesthesia are detailed as follows: Two patients had bronchitis, four atelectasis and eight a diagnosis of pneumonitis. None of the complications were serious or failed to respond promptly to

treatment except for one patient who died from pneumonia. There were no major postoperative complications of the circulatory system. The average postoperative hospitalization was nineteen days per patient.

#### CONCLUSIONS

In this group of patients submitted to subtotal gastrectomy, the anesthetic management described offered definite advantages and produced good results. It is believed that with it a great degree of flexibility by way of individualizing each single case to meet the physiological requirements as presented was possible, and that there were certain definite advantages to the surgeon.

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# GASTRIC RESECTION WITH THE DE PETZ MECHANISM\*

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ONE of the most intriguing chapters in all medicine is that phase of surgery which deals with the technic of performing gastric and intestinal resections and anastomoses. The task has been a difficult one because of the nature of this long, potentially septic, thin-walled organ whose functions vary at different points. Many new methods and instruments have evolved through the years, some of which have become indispensable procedures and others have fallen by the wayside because of their awkwardness. These procedures may be placed into three groups: first, the hand method; second, the clamp method; and third, the sewing mechanism. The sewing mechanism is the simplest and in our opinion the most aseptic, hemostatic and rapid method yet developed.

The voluminous, ever changing literature on gastrointestinal surgery is itself evidence of the hit and miss progressive nature the solution of the problem has assumed. H. H. Kerr points out that the first mention of the technic of intestinal surgery is in Lanfrank's "Science of Chirurgie," published in 1396. In 1812, Benjamin Travers performed a research study showing that healing of intestinal wounds was by agglutination of the visceral peritoneum at the edges of the wound in the intestine to the peritoneum of adjacent viscera or to the parietal peritoneum. This agglutination theory had been known for 400 years but Travers showed it was not necessary to anchor the visceral and parietal peritoneum as it was previously thought. Antoine Lembert, in 1812, showed that intestinal wounds heal by adhesion of the inverted peritoneal coats and not by the adhesion of the adjacent cut edges. The

foundation of gastric surgery was laid in 1875 by Gussenbauer and Winniwarter who first reported gastric resections in dogs. This work was suggested by Billroth who later was the first to perform successfully a gastric resection on a human. Pean (1879) and Rydygier (1880) had previously attempted this on humans without success. In 1892, Murphy introduced steel buttons with which to approximate anastomoses. This was quite successful and lent great impetus to the popularity of intestinal surgery. The great danger of the button lodging in the stomach or small bowel and producing an obstruction is its main disadvantage. The Murphy button was replaced by the suture method and Kerr points out that up to 1923 there were already about 250 different suture methods in the last century.

In like manner, a great number of clamps have been devised to facilitate intestinal anastomoses but the only instruments of use in gastric resection have been the sewing mechanism type herein discussed. These instruments are the ingenuous result of the surgeons' desire to simplify gastric surgery, shorten the duration of the operation and minimize the spilling of gastric contents with complete hemostasis. The de Petz instrument though relatively new (1927) was evolved over a period of thirty years. Michailoff, in 1897, first recommended the sewing machine stitch in plastic surgery and Quain applied the stitch to gastric and intestinal anastomoses in 1916. It was Florian Hahn who, in 1910, first demonstrated an instrument for mechanical stitching of the stomach and intestines. This consisted of a stitching mechanism contained in a plate-like struc-

\* From the Department of Surgery, Chicago Memorial Hospital. Read before the American College of Surgeons Meeting at Chicago Memorial Hospital, October 21, 1940.

ture which moved on a pair of blades that are clamped together.

A most ingenious instrument was de-

inward. Neuber, Emerson and Czirer have successfully used this instrument in doing an end-to-side gastrojejunostomy following

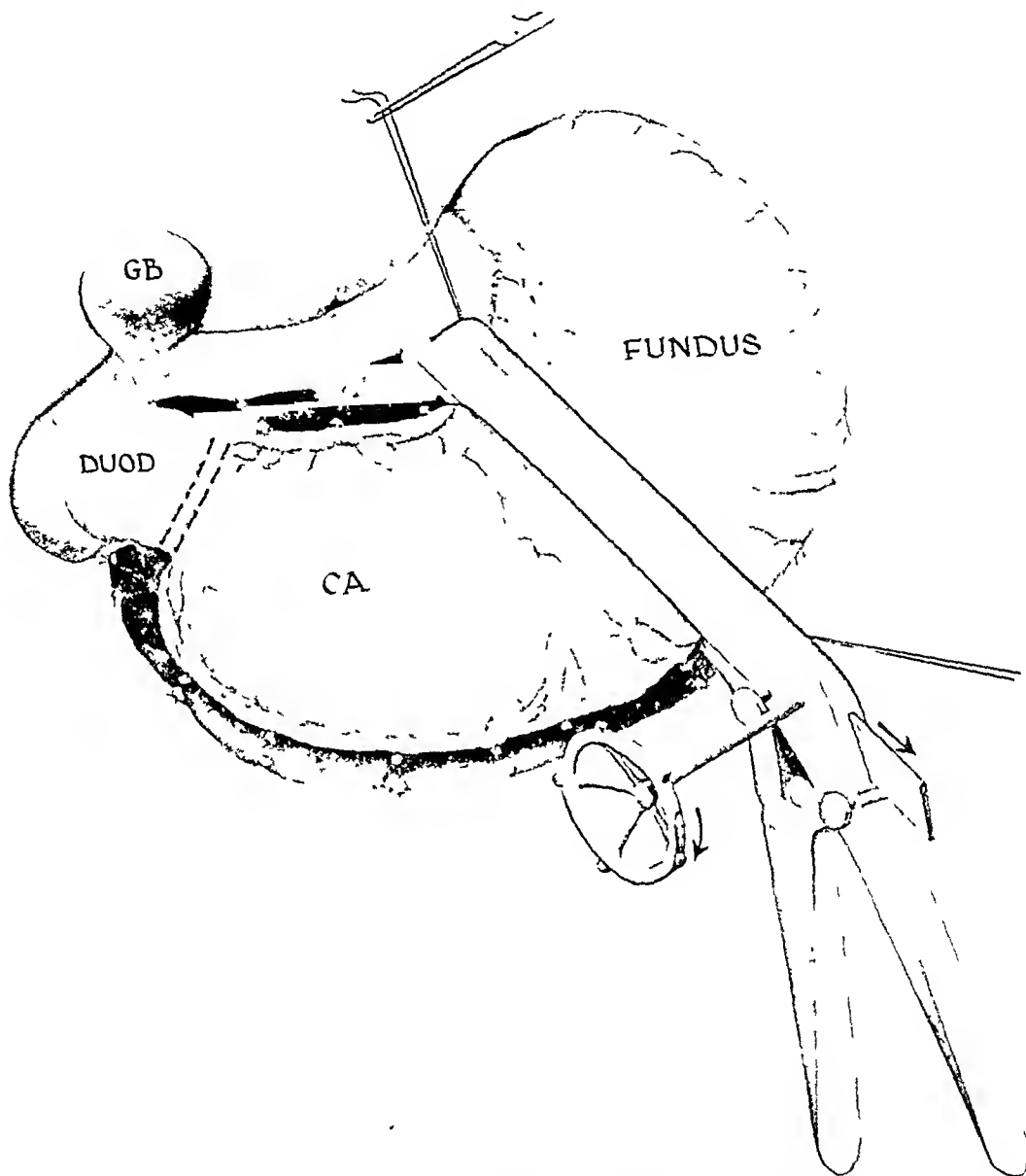


FIG. 1. Ligation of the vessels in the lesser and greater curvatures of the stomach accomplished, with the duodenum already sewn by the de Petz instrument. In the fundus of the stomach, note the instrument in place for operation.

scribed in 1911 by Hülth and Fischer. It is upon the design of this instrument that de Petz's instrument is based. In brief, this Hülth-Fischer sewing mechanism consists of two parallel jaws. The staples enter concave grooves on the lower jaw which close them by forcing the staples upward and

gastric resection for many causes. In 1927, Neuber reported 2,400 gastric resections performed with this instrument and the mortality was reduced from 7.8 to 4.8 per cent. Emerson and Czirer had a mortality of only 3.3 per cent in 100 cases. One of the reasons for a lower mortality was thought

to be the rapidity with which the operation could be performed. One hour and a half was the maximum time usually required.

much simpler and easier to handle and comes closer to furnishing an aseptic, hemostatic, rapid method of provisional

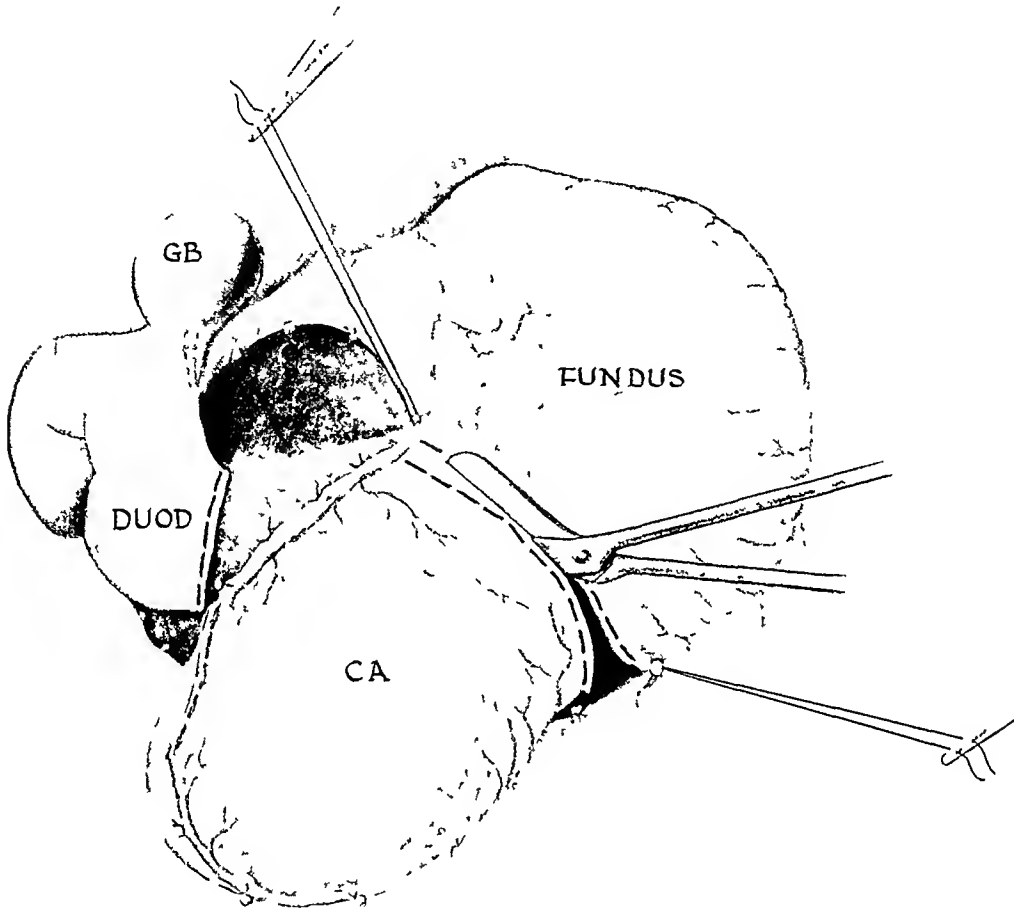


FIG. 2. The duodenal end has been cut with a straight scissors between the rows of clips, the fundal end being in the process of division with scissors in the same manner.

Neither the Florian Hahn nor Hültl-Fischer sewing mechanisms gained widespread popularity because they were heavy, complicated and clumsy. So again, as in the past, when a new method or instrument was discarded, the hand method boomed in popularity. This is exemplified in the reports of the sewing machine of Quain (1912, 1917) the double needle holding clamp of Walker (1917), the spring thumb forceps of Chaffin (1919) and the serrated clamp of Scott (1925). All these were used for a while only to fall into disfavor later.

A. de Petz, in 1927, introduced the most efficient sewing mechanism to date. It is

closure of both ends of a resected stomach than other procedures. As pointed out by de Petz the handmade closure of a gastric or intestinal stump after resection is very difficult especially if it is high and retracted. It is not aseptic for the needle is contaminated by being passed through all the stomach tissue and its contents. It is now well known that the high mortality of gastric resections is usually due to contamination of the peritoneum by the infected contents of the cancerous stomach either during the operation or to the leakage of contents postoperatively. The chief use of the de Petz instrument is in applying

a rapid hemostatic double row of staples for provisional closure of the gastric and duodenal stumps. It requires only about

ness of the instrument is best illustrated in the following operations: Hoffmeister modification of the Pólya method of gastric

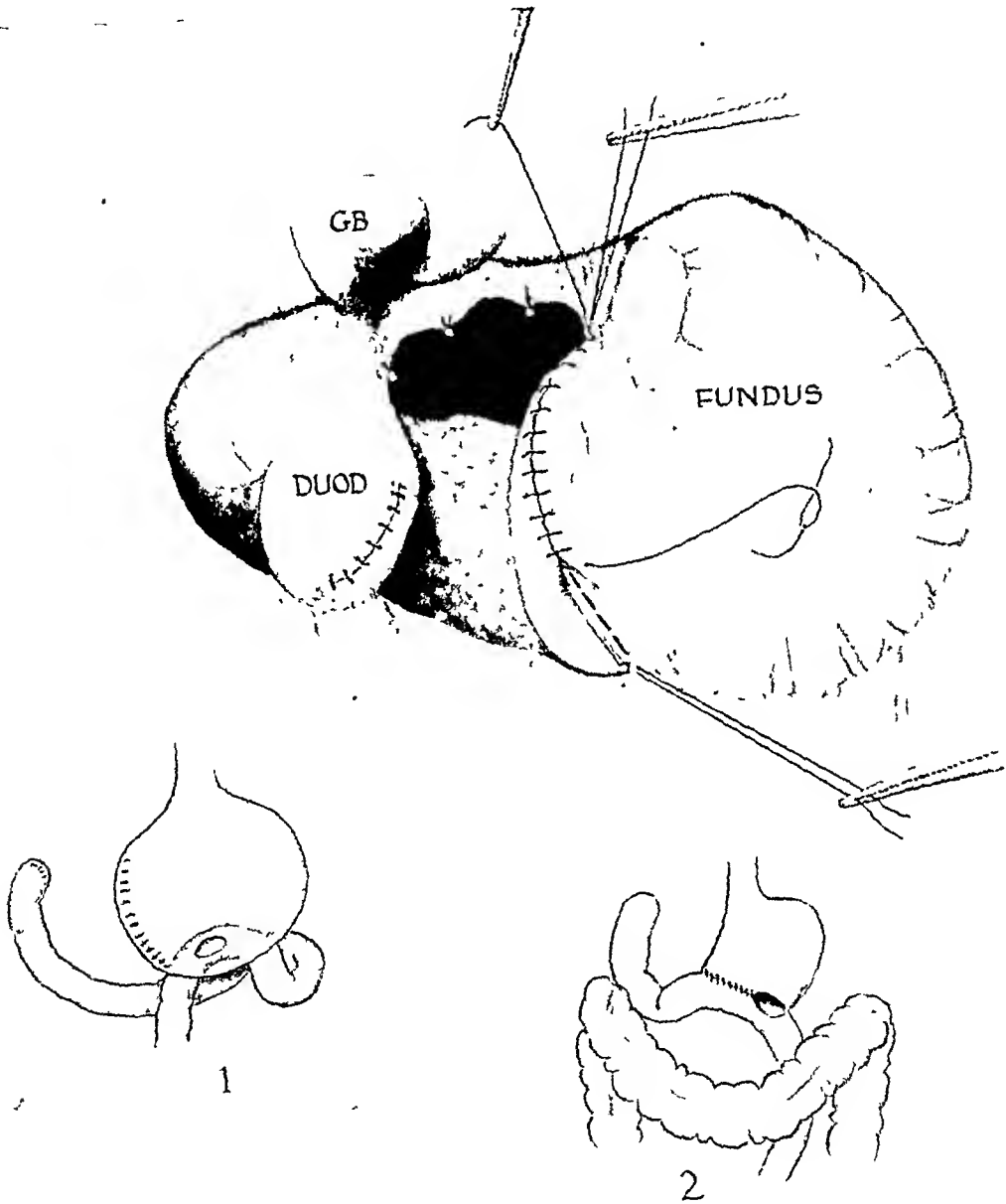


FIG. 3. The upper diagram shows the duodenal stump peritonealized with a row of silk or gastrointestinal catgut, and the fundal end in the process of being handled in the same manner. No. 1 shows the manner of handling in the case of a Billroth-II type of operation. No. 2 shows the manner of closure in a Hoffmeister modification of the Pólya with the end-to-side procedure. These may be done either ante- or posterocolic.

ten seconds to close each end. The lumina are never open and we believe that this method of mechanically suturing the stomach provides the greatest safeguard against spilling of the gastric contents. The useful-

resection with end-to-side gastrojejunostomy, Billroth II gastric resection with posterior gastrojejunostomy or anterior gastrojejunostomy with lateral anastomosis of the ascending and descending loops of

the jejunum, gastric resection followed by gastroduodenostomy, and exclusion operation for antral carcinoma.

In 1934, Friedrich Neuffer Ullrich modified the de Petz instrument. This modification contains a magazine that can be refilled and only one instrument is necessary; however, it is our opinion that this is much too cumbersome.

#### TECHNIC

The chief steps in the technic of gastric resection are as follows: The gastrohepatic and gastrocolic ligaments and the adjacent vessels are doubly ligated, care being taken to include all visible nodes. The involved portion of the stomach is freed and the de Petz instrument is applied at the pyloric end of the stomach, the small ring is placed over the end of the instrument crushing the tissue tightly. The wheel is turned seating the staples so that a double row of clips is placed within the tissue. The same application is made to the proximal end of stomach. The stomach is divided with scissors between the two rows of clips, excising the diseased portion of the organ. Then with a single silk linen or gastrointestinal suture the row of clips at both the pylorus and proximal end of the stomach is buried and peritonealized. Interrupted sutures are placed to stop any bleeding or to cover any raw surfaces. If the transverse colon is involved, it may be resected with the use of the same instrument. A gastrojejunostomy is then performed by whatever method is preferred or indicated. If the pancreas is involved, drains are left in the lesser peritoneal sac, otherwise no drainage is necessary.

#### CONCLUSION

The simplest, easiest and most rapid method of performing an aseptic, hemostatic, provisional closure of both ends of a resected stomach is with the de Petz sewing mechanism.

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# COMBINATION OF LOCAL AND GENERAL ANESTHESIA IN OBSTETRICS\*

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IT has been claimed and indeed many careful observers believe that they have conclusively shown that local anesthesia is far safer for the patient than is general anesthesia.

The present political emergency with its consequent shortage of trained intern and resident anesthetists has stimulated my interest in the use of local anesthesia in all my operative procedures, especially those in obstetrics.

For some time now, I have been following the lead of DeLee and Greenhill in the employment of local anesthesia in the performance of cesarean section. The results in these cases have been highly satisfactory. My experience with this method of anesthesia has convinced me that the patients so operated upon withstand the operation and convalesce better than those patients upon whom I formerly operated under general anesthesia. I am especially impressed by the great diminution in the blood loss in the average case, the freedom from shock and the ease and speed with which respiration is initiated in the baby.

Although I have personally performed the operations of low, midforceps and breech extractions in patients in whom the only anesthetic used was procaine infiltrated locally, nevertheless, I reserve this procedure at present for those patients suffering from complications such as toxemia of pregnancy, infections of the respiratory tract, etc.

This technic has been altered from purely local infiltration to a combination of local infiltration plus general for the following reasons: many of the patients are "fagged

out," an appreciable percentage are neurotic, some are frightened and others are excited. Women under the conditions just mentioned cannot be expected to co-operate with the obstetrician for any length of time especially when they must remain in the uncomfortable lithotomy position for the duration of the operation. The administration of a small amount of ether by inhalation to these patients has a better effect on them than the drugs usually employed to produce "twilight sleep."

## TECHNIQUE

When the patient is deemed ready for delivery, she is placed on the obstetrical table and prepared in the usual manner. No anesthetic is administered until the obstetrician has completed his scrub and is gowned, gloved and ready to operate. Ether is then administered through an open mask and as soon as the patient is seen to be under, the injection of  $\frac{1}{2}$  per cent procaine in normal saline solution is started.

The setup includes a 10 or 20 cc. syringe, a sterile calibrated medicine glass and three needles, one No. 18 gauge 1 inch in length, a second No. 20 gauge 3 inches in length and a third No. 20 gauge,  $1\frac{1}{4}$  inches in length.

The infiltration is commenced by the submucous injection of the anesthetic solution into the levator muscles and fascia and into the tissues of the perineum on each side of the midline. The mucocutaneous junction is next infiltrated and from the midpoint of this junction about 20 cc. of solution is injected submucously in a fan-wise manner. Fifty to 60 cc. of procaine

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solution is usually sufficient for injecting all the structures mentioned.

Before injecting any solution, one must

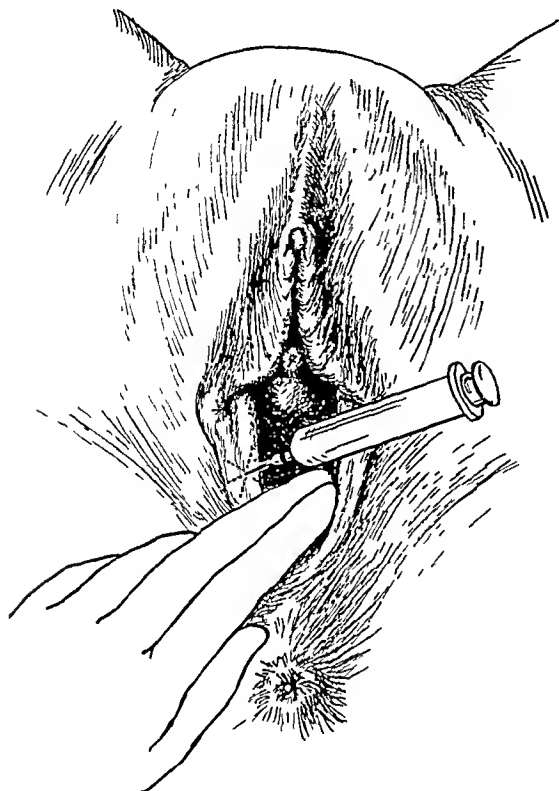


FIG. 1. Injection of perineal tissues.

be sure that the needle is not in a blood vessel. This is easily ascertained by pulling back the plunger of the syringe. Absence of blood in the syringe indicates that the needle has not entered a blood vessel.

The bladder is now emptied by catheter following which the perineum is ironed out as described by Potter. On ironing out the perineum one is instantly struck by the fact that the muscle bellies which have been rigid and taut just prior to the injection of the anesthetic solution are now soft and butter-like in consistency. Another striking fact is soon learned, namely, that while without the infiltration of anesthetic solution "ironing out" cannot be properly performed until the patient is rather deeply anesthetized because of the persistence of the perineal reflex, however, when "local" is added it can very easily be done with the patient only lightly under the influence of the general anesthetic.

The necessary manipulations such as manual rotation, forceps application and delivery, episiotomy, etc., are now performed, the patient meanwhile being kept "lightly" under the influence of ether.

Immediately following the delivery, the ether mask is removed, or if allowed to remain on the patient's face, no more ether is administered except on the obstetrician's request. One cc. of either pituitrin or pitocin is then injected intramuscularly; and if the placenta presents in the cervix or vagina, it is gently expressed by fundal pressure. If the placenta does not present and if uterine bleeding is negligible, repair of the perineal laceration, if any, or of the episiotomy wound is commenced. Should the patient move or moan during the repair it usually suffices to inject a few cc. of the procaine solution into the tissues to be repaired.

On completion of the repair the ether mask is removed, if it has not already been, and if the placenta has not yet been delivered the obstetrician stands by until it is. After the delivery of the placenta 1 cc. of ergonovine malleate alleate is injected intramuscularly and the patient is closely observed on the obstetrical table for one hour before being moved to her room.

I have employed this combination of general and local anesthesia in eighty-five cases. These cases include only patients in whom obstetrical operations were performed. Patients delivering spontaneously or in whom local anesthesia was employed only for the repair of a laceration or of an episiotomy wound were excluded from this series. The operations performed included low and midforceps, breech extractions, manual rotation of the occiput, podalic version, Duehrssen's incisions of the cervix and forceps delivery of the aftercoming head. There were no maternal deaths. Complications occurred in two cases.

CASE 1. There was a mild postpartum hemorrhage in a woman in whom I had removed an ovarian cyst in the fifth month of her pregnancy. The loss of blood was not severe enough to necessitate a blood transfusion or

intravenous infusion. Injections of oxytocic drugs sufficed. Mother and baby left the hospital on the tenth postpartum day.

CASE II. This patient evidenced a pulmonary complication and x-ray disclosed patches of lung consolidation. The patient was delivered by low forceps and the perineal muscles were so relaxed that it was unnecessary to perform an episiotomy. The patient came out of her anesthetic long before her removal from the delivery room and it was noted that she had a hacking cough.

On close questioning the patient recalled that she began to cough a day or so before entering the hospital. While it is possible that the bronchopneumonia in this case resulted from the anesthetic, nevertheless the history of cough before admission makes it more probable that the process originated before delivery. Both she and the baby left the hospital in good condition.

There were four fetal deaths. Two infants were born prematurely at the end of the sixth month of gestation. One of these cases was complicated by abruptio placentae. The third case occurred at full term. There were tight coils of umbilical cord about the neck in a case complicated by a Bandl's contraction ring. The fourth death occurred in a full term infant. There was a cephalopelvic disproportion and forceps had been unsuccessfully applied before I was called in consultation. Delivery was effected by podalic version and the aftercoming head was delivered by forceps. The fetus was stillborn.

#### DISCUSSION

Tovell, writing in Curtis' System, states that it has been noted by surgeons and anesthetists alike, that field block, associated with light narcosis by inhalation, entails the least risk for debilitated and anemic persons for whom exploratory laparotomy is indicated. He is somewhat critical of infiltration anesthesia stating that it is useful for minor operations, but because the wound is less likely to heal by first intention, other and more comprehensive methods have been devised. I cannot agree with this latter statement for even in

an area as infected as the female perineum usually is, nevertheless over 95 per cent of the repaired episiotomy wounds in this series healed by what for all practical purposes amounted to primary union.

In the numerous year books of Obstetrics and Gynecology, edited by DeLee, he has for years advocated the employment of local anesthesia in obstetrics. Greenhill<sup>2</sup> in his book entitled "Obstetrics and General Practice" lists the following as some of the advantages of direct infiltration anesthesia: There is practically no mortality, there are no pulmonary complications directly attributable to this procedure thus making it of special importance in the delivery of women who have pulmonary conditions such as tuberculosis, bronchitis, asthma and influenza. Except for the possible breaking of a needle during injection or the accidental injection of the anesthetic solution directly into the blood stream, there are no general complications. He also goes on to enumerate additional advantages, namely, the technic is simple and may be used in a home as well as in a hospital, there are no ill effects on vital organs. . . .

Gellhorn<sup>3</sup> claims that practically all gynecological vaginal operations can be performed under local anesthesia. He states that it is an indispensable requirement to put the patient into a deep "twilight sleep" by means of morphine scopolamine injections. He advocates the use of weak procaine solutions ( $\frac{1}{4}$  per cent) in normal saline. The more copious the infiltration, says he, the more complete is the analgesia; and as the extremely weak procaine solution is practically isotonic, there need be no fear of toxicity and there is no danger of devitalizing the tissues, particularly if the fluid is injected at body temperature. In the same article he is enthusiastic about the use of local infiltration anesthesia in obstetrics.

Walker<sup>4</sup> writes that local block and infiltration anesthesia have a wide application in obstetrics. It is his impression that the blood loss during and after the third

stage is diminished when local anesthesia is employed.

Bansillon and Bucker<sup>5</sup> make a plea for the more extended use of local infiltration of the perineum during labor either alone or in combination with a general anesthetic.

Magnus P. Urnes and Timmerman<sup>6</sup> discuss the results of a large series of breech deliveries in the home and they are convinced of the efficacy of local anesthesia in these cases.

Although I have not measured the blood loss after combined general and local anesthesia, my general observation has been that the blood loss is much smaller than when general anesthesia alone is used.

The majority of the patients are either semi- or fully conscious before the completion of the perineal repair and the reason for this is very obvious: they were never very deeply anesthetized. As a result pulmonary complications such as massive collapse of the lung, aspiration pneumonia, etc., should occur less frequently than when general anesthesia alone is employed. Emboli should occur less frequently for the tissues must of necessity be handled more gently since under the combined method of anesthesia the patient is only lightly anesthetized.

Two troublesome complications that may occur can fortunately be easily prevented: The first is the breaking of a needle employed in injecting the solution and the second is the accidental injection of the procaine solution directly into the blood stream.

One can avoid breaking a needle by using only those of the best quality and since needles usually break near the hub one should never insert the needle to its full length. The method of avoiding the second complication has been described.

The after-care does not materially differ from that given patients delivered under general anesthesia. However patients receiving local anesthesia seem to have less perineal discomfort and less "gas pains."

The quality of the pulse, its rate and rhythm and the color of the skin imme-

diately after delivery is much closer to normal in those receiving the combined anesthesia.

#### SUMMARY

Combined infiltration and general anesthesia was employed in a series of eighty-five cases.

There were complications in two cases. One patient had a moderate postpartum hemorrhage. Another patient developed bronchopneumonia which probably originated in the usual manner before admission to the hospital, or might possibly have been due to aspiration.

There were four fetal deaths none of which could be ascribed to the anesthetic.

#### CONCLUSIONS

The administration of a small amount of ether by inhalation plus local perineal infiltration of  $\frac{1}{2}$  per cent procaine in normal saline solution makes a very suitable and efficient anesthetic combination for parturient patients.

This combination anesthesia is of especial value in communities where the services of expert anesthetists are difficult to obtain.

Patients operated upon under the influence of this combined anesthetic react better than those operated upon under inhalation anesthesia.

Fewer complications are encountered when the combined anesthetic is employed.

This form of combined anesthesia is safer than inhalation anesthesia.\*

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\* Since submission of this paper, thirty-eight additional patients have been operated upon under "combined" anesthesia.

# POSTOPERATIVE VESICOVAGINAL FISTULAS

## GENESIS AND THERAPY

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IN the early reports of operations for vesicovaginal fistula there were very few postoperative fistulas. During the past forty years this has changed due to the rapid development of operative gynecology.

The present study of ninety-seven vesicovaginal fistulas seen over a period of thirty years shows twenty-eight obstetrical, sixty-five postoperative and four fistulas of other origin. The percentage relationship of obstetrical to postoperative fistulas in this series is 30:70. Similar percentages are reported by Frommolt and Stamatiades,<sup>20</sup> 29:71 per cent.

This marked increase in the postoperative vesico- and ureterovaginal fistulas is mainly due to the frequency of hysterectomy and especially to the radical operation for carcinoma of the cervix (Sampson,<sup>46</sup> Franz,<sup>18</sup> Wertheim,<sup>60</sup> Lower<sup>33</sup>). This can be readily understood if one bears in mind that radical surgery for malignant disease of the cervix requires very extensive bladder dissection, occasionally with intentional or unintentional bladder injury.

In the sixty-five postoperative fistulas reported in this study the basic operation was: thirty-six cases of carcinoma of the cervix uteri (including one case of carcinoma of the vagina); fourteen cases of myoma uteri; fourteen cases of other gynecological diseases; and one case of carcinoma of the sigmoid flexure of the colon (with resection of the bladder).

Of the thirty-six cases of carcinoma of the cervix four of the patients were originally operated upon in other clinics. (Nos. 16, 33, 60, 63.) Case 64 developed a fistula fifteen years after combined operative and radium treatment for cervical malignancy. The remaining thirty-one cases

of vesicovaginal fistula developed during the convalescence from the original operation for cervical cancer. These occurred in approximately 1,300 radical operations, 1,200 abdominal and 100 vaginal hysterectomies. In seventeen of the thirty-one cases the records show bladder injury, intentional or otherwise, at the primary operation: five resections of the bladder wall (Nos. 1, 2, 3, 48, 61); two deliberate injuries because of involvement of the bladder (Nos. 15, 56); four accidental injuries (Nos. 7, 17, 32, 59); six difficult separations of the bladder because of involvement or fixation of the bladder by the neoplasma (Nos. 6, 8, 10, 51, 52, 58).

One must assume that the cause of the vesicovaginal fistula in the remaining fourteen cases was gangrene of the bladder following extensive dissection with resulting interruption of its vascular and nervous supply. In seven cases the gangrene of the bladder could be observed by vaginal and cystoscopic inspection (Nos. 1, 3, 4, 5, 8, 11, 19). Cases 3 and 4 developed gangrene after resection. Occasionally, it was seen at postmortem examination following radical operation for cervical cancer. (Fig. 1.) The gangrene shows itself first on the mucous membrane and then involves the entire thickness of the bladder wall, similar to ureter necrosis studied by Stoeckel.<sup>54</sup> The interureteric ligament is more resistant and better nourished than the rest of the bladder and is ordinarily not involved, even though not only the fundus of the bladder but also the vesical trigone becomes necrotic and sloughs. (Fig. 2.) After the necrotic tissue sloughs away the bladder communicates directly with the large wound formed in the pelvic connective tissue by the radical operation

and only indirectly with the vagina. Following healing and cicatrization of the wound in the pelvis there remains at the



FIG. 1. Gangrene of the bladder following radical hysterectomy for cervical cancer.

bottom of the vaginal funnel a vesical fistula fixed in rigid scar tissue.

The inferior margin of the fistula usually coincides with the resistant interureteric ligament. In consequence, one or both ureteral orifices may open directly into the margin of the fistula. (Fig. 3.)\*

Summarizing, one may say that the occurrence of vesicovaginal fistulas following hysterectomy for uterine carcinoma is unavoidable within certain limits, insofar as these fistulas represent a sequelae of intentional injury or the end result of bladder gangrene. They must be considered a necessary risk of radicalism in operations for cancer of the cervix. Diminution in the frequency of postoperative fistulas might be attained only by a renunciation of radical surgery, which would be a step backward. These factors do not apply to vesicovaginal fistulas subsequent to other gynecological operations. Fourteen fistulas in this series followed operations for myoma. None of them was originally operated upon in our clinic. In more than 1,000 subtotal and total hysterectomies

for myoma performed in our clinic, vesical fistula as a complication never occurred. Fourteen fistulas, however, occurred following other gynecological operations. In these twenty-eight cases surgical injury to the bladder was the probable cause of the fistulas.

The well known operative difficulties in the management of postoperative vesicovaginal fistulas may be summarized under the following headings: (1) Inaccessibility of the fistulas; (2) impossibility of mobilizing the bladder in cases of vesicovaginal fistula following radical hysterectomy, without at the same time, opening the peritoneum or endangering the rectum, and (3) danger of injury to the ureters in the dissection or in the suture of the fistula.

1. *Inaccessibility* due to depth or fixation of the fistula played an important rôle even in the era of the obstetrical fistulas. As early as 1856, Brown J. Baker<sup>8</sup> recommended the use of a typical episiotomy in such fistulas. A better approach was afforded by the deep vaginoperineal incision, an extended episiotomy, as proposed by Duhrssen for other vaginal operations. This had been recommended by Mackenrodt<sup>35</sup> in 1894, and almost simultaneously by Chaput,<sup>9</sup> von Hofmeier,<sup>25</sup> Douglass Marion,<sup>37</sup> and many other authors as a preliminary to the fistula operation.

The so-called Schuchardt incision makes the operative field still more accessible. This incision introduced by Schuchardt<sup>47a</sup> (1893) and called the "parasacral" incision was first successfully used by him in the course of an operation for high vesicovaginal fistula in 1896.<sup>47b</sup> The Schuchardt incision of that time differed from Duhrssen's deep vaginoperineal incision only in the fact that it was carried up into the vaginal vault and then downward and outward nearly to the tip of the coccyx, thereby encircling the anus. Schuchardt writes explicitly, "For comfortable accessibility the levator need not be cut through. The incision leaves the levator funnel entirely untouched."

\* Duncan, Cameron:<sup>12</sup> "After hysterectomy or irradiation, most fistulae are in close proximity to the ureteral opening."

The Schuchardt incision, now in general use, called by him "paravaginal" incision, was proposed in 1901 as an introductory

our own experience the deep vaginoperineal incision of Dührssen is adequate even in the difficult cases, while deep episiotomy suf-



FIG. 2. The retained interureteric ligament in a case of vesicovaginal fistula following successful operation. Visualized by cystoscopic examination as a string across the bladder. Small concretion also seen.

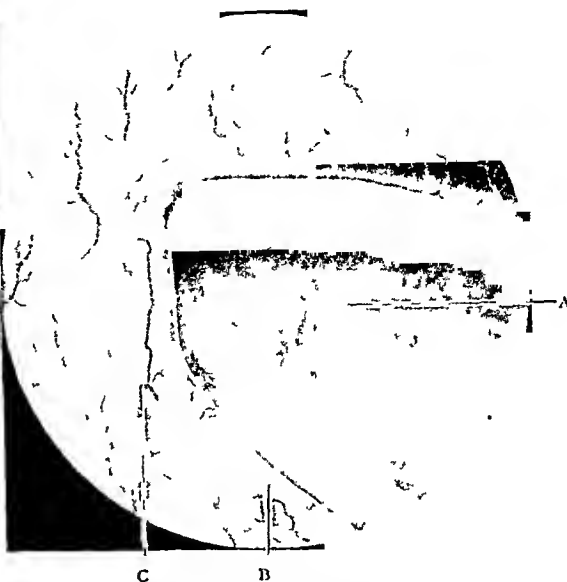


FIG. 3. Cystoscopic picture of bladder following colpocleisis. A, diverticulum into vagina; B, edge of interureteric ligament; C, ureteral opening.

step in the radical vaginal operation for carcinoma of the cervix. It differs from the original Schuchardt "parasacral" incision principally in cutting through the levator ani and coccygeus muscles. By means of this incision the ischiorectal fossa is opened so widely that the operative field in the pelvis, after the rectum has been forced back, becomes almost superficial and does not lie in the depths of a funnel.\*

The use of the Schuchardt incision in the less accessible cases of vesicovaginal fistula has been favored by many authors, including Küstner,<sup>30a</sup> Kelly,<sup>28a</sup> Stoeckel,<sup>55</sup> Ward,<sup>59</sup> Bengolea and Bazterrica<sup>6</sup> and Keller.<sup>27</sup> In

\* It is noteworthy, however, that Maisonneuve,<sup>36</sup> more than forty years previously (1851) had used and at the latest, in 1864, had accurately described the same procedure in order to make difficult fistulas accessible. In his *Clinique Chirurgicale*, Paris, 1864, he states: "I then cut the perineum in its whole extent at the left side of the rectum which I pushed back and I prolonged the incision toward the ischiadic incisure; by that large opening I could easily advance to the ground of the vaginal cul-de-sac." It may perhaps be mentioned at this point that far too little credit is given to Maisonneuve who was also the first to carry out complete mobilization of the bladder in the manner later advocated by Mackenrodt.

fices if inaccessibility is of moderate degree. It is only in the exceptional case that it is necessary to resort to the paravaginal incision of Schuchardt which is usually accompanied by excessive hemorrhage.

2. *Impossibility of Mobilization.* It was early recognized that the application of the typical obstetrical fistula technic of Sims, denuding the edges and suture, or that of Mackenrodt, mobilization of the bladder, was rather difficult in fistulas following total hysterectomy. In these cases, the posterior margin of the fistula coincides with the scar in the vault of the vagina. (Fig. 4.) On splitting the latter by means of a transverse incision, one proceeds for a short distance between the rectum and the bladder, which here are adherent to one another, and then promptly enters the pouch of Douglas, i.e., the free peritoneal cavity. Even if the danger resulting from possible injury to the rectum is regarded lightly and even though the presence of virulent pathogenic bacteria in cases of vesicovaginal fistula is rather rare, the occasionally observed infection of the

peritoneum following transperitoneal fistula operations, shows that there is definite danger in such a procedure.

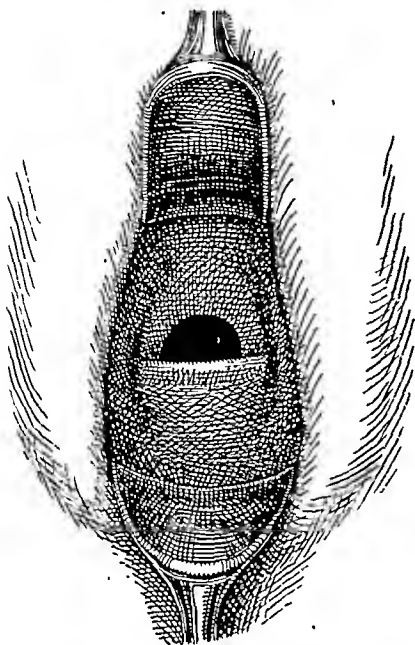


FIG. 4. Vesicovaginal fistula following total abdominal hysterectomy. The posterior edge of the fistula coincides with the transverse scar of the posterior vaginal wall.

A number of authorities consider it difficult to avoid opening the peritoneal cavity in the course of the vaginal operation for fistula following hysterectomy (Hofmeier,<sup>25</sup> Stoeckel,<sup>55</sup> Saenger,<sup>44</sup> and others). Some authors have made a virtue of necessity and advise the immediate opening of the peritoneum (Asch,<sup>3</sup> Kelly,<sup>28a</sup> Halban<sup>21</sup>). But they all agree that the scar tissue fixation of the margin of the fistula makes mobilization of the bladder and its suture extraordinarily difficult. Aldridge<sup>1</sup> (1939) emphasizes the fact that in these cases "Sims technique is difficult to apply and it is impossible to bring the denuded surfaces in exact apposition." This applies especially to fistulas which have occurred as a result of gangrene of the bladder following Wertheim's operation (André et Grandineau,<sup>2</sup> 1923). In these cases the posterior edge of the fistula is fixed by the rigid transverse scar in the vault of the vagina so that it cannot be

sutured without excessive tension. This scar also makes any attempt at a typical mobilization of the bladder by the method of Mackenrodt hopeless. In those cases in which mobilization and transverse suture of the fistula have nevertheless been successfully accomplished one may be sure that the cause of the fistula formation was not bladder gangrene following radical operation for carcinoma of the cervix. Cases 32 and 34 in which one or another of the usual methods was used at operation may serve as examples. In both cases the fistula was the result of bladder injury.

3. *Danger of Injury to the Ureter.* The ureters may present a special complication by their relationship to the fistulas which occur after extensive radical operation for carcinoma of the cervix. This operation presupposes the extensive removal of the parametrial and paravaginal tissues. Across the large wound the ureters run as naked cords. The healing of this cavity occurs by granulation and leads to the formation of dense scars which extend from the top of the vagina toward the pelvic walls and ensheath the ureters almost inseparably (Wertheim,<sup>60</sup> Latzko,<sup>31</sup> André et Grandineau: "Fixation of the Ureter by Scars," Koster:<sup>29</sup> "Encroachment of Ureters"). Any attempt to dislodge these ureters in order to avoid their injury in suturing the bladder or for implanting them is doomed to failure because of the impairment of their vitality.\*

The aforementioned three difficulties have caused many authors to abandon the vaginal route of operation and to attempt the closure of the bladder defect by the suprapubic route.

\* The opening of the ureters into the margin of a fistula and the fixation of the ureters by scar tissue represented a serious complication seen in obstetrical fistulas. In 1867, Simon<sup>31</sup> recommended transposition of ureter openings in the border of a vesicovaginal fistula into the interior of the bladder by splitting the anterior wall of the ureter. Pawlik<sup>41</sup> (1883) to avoid ureter injuries, recommended their preliminary catheterization. The author<sup>31a</sup> (1933) in such cases recommended ensheathing of the exposed ureters in the bladder musculature.

The oldest suprapubic fistula operation is the transvesical, extraperitoneal method proposed by Trendelenburg<sup>57</sup> in 1885. It has since been used and warmly recommended by McGill,<sup>34</sup> Kelly,<sup>38b</sup> Marion,<sup>37</sup> Young,<sup>63</sup> Aldridge<sup>1</sup> and others. Its technic consists in the visualization of the fistula by a transvesical incision with the patient in high Trendelenburg position (introduced by Trendelenburg for this purpose). The fistula is exposed and a circular incision is made through the mucous membrane of the bladder, paying special attention to the course of the ureters and the location of their orifices.\* The bladder is separated from the vagina and the two openings are sutured in layers. To facilitate exposure of the fistula Weinlechner<sup>62</sup> (1893) proposed the use of a ball equipped with a wire. The ball is introduced into the vagina and the wire passes through the fistula into the urinary bladder; traction on the wire brings the fistula into the field. Falk has used a tampon for the same purpose. (Fig. 5.) The results achieved according to Sear's<sup>48</sup> collected statistics of fifty fistulas so operated upon were: Cured forty; improved two; not cured five; and deaths three. Individual authors have, to be sure, achieved better results. Marion<sup>37</sup> performed thirteen operations, all successful and Young eleven operations, all successful.

It is not surprising that this method is used especially by urologists to whom the approach by way of the bladder is a familiar one. They designate this operation as an easy one (Marion,<sup>37</sup> Chwalla<sup>10</sup>) whereas to most gynecologists it seems difficult (Fritsch,<sup>19</sup> Stoeckel,<sup>55</sup> Zweifel,<sup>65</sup> Bengolea and Bazterrica<sup>6</sup>). As a matter of fact, in fat women the field of operation is very deep and relatively inaccessible. The transvesical opening of the bladder may be very difficult if the bladder capacity is substantially reduced as is usually the case

in the presence of longstanding vesicovaginal fistulas.

At this point one may also mention

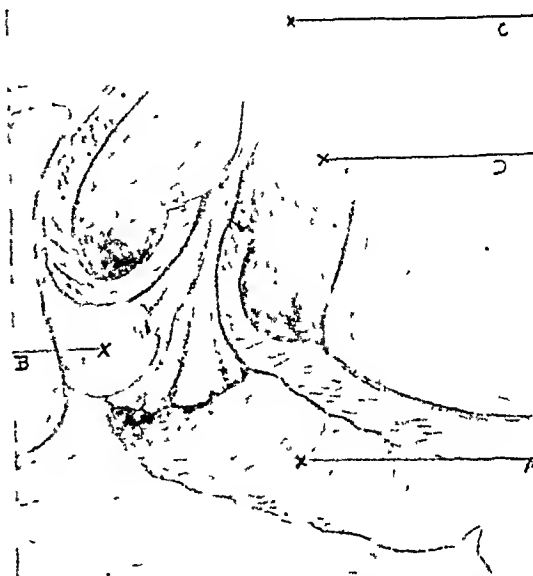


FIG. 5. A, vagina; B, cervical stump; C, clamp grasping the gauze through fistulous tract, drawing it up to the suprapubic wound (D). (Falk, *Il. C. Surg. Clin. N. A.*, June, 1930.)

Bardenheuer's<sup>5</sup> (1887) operation by way of a transverse suprapubic incision which Bumm replaced by a longitudinal one. This operation scarcely comes into consideration for postoperative fistulas since its principal object, the separation of adhesions between bone and fistula margin, concerns obstetrical fistulas exclusively.

The transperitoneal method suggested by Dittel<sup>11</sup> which originally was designed only for vesicocervical fistulas has been widely used. (Figs. 6 and 7.) Its principle consists in the separation of the bladder from the genitalia in the region of the fistula by way of the abdominal cavity opened by laparotomy and the separate suturing of the bladder, the cervical and the vaginal defects, respectively. This operation has been recommended by Chaput,<sup>9</sup> Forgue,<sup>17</sup> Zweifel,<sup>65</sup> Hannes<sup>22</sup> and Koster<sup>29</sup> for high postoperative vesicovaginal fistulas. Individual authors have achieved very good results with this procedure as for example Zweifel<sup>65</sup> who performed eight Dittel operations with eight cures.

\* The importance of this precautionary measure is illustrated by the well known case of Everke.<sup>14</sup> His patient died of uremia in consequence of the ligation of both ureters in the course of a Trendelenburg operation.

TABLE I  
VESICOVAGINAL FISTULAS—HIGH OCCLUSION OR OBLITERATION OF THE VAGINA

No.	Name, Age	Basic Disease, Original Operation	Formation of the Fistula	Operation	Further Observations	Result	Remarks
1	M N 40	Carcinoma of the cervix, anuria, hematuria. Radical abdominal operation Dec. 1908. Resection of both ureters with implantation into the bladder. Resection of posterior bladder wall.	During convalescence, there was gangrene of the bladder, with the formation of a vesicovaginal fistula 5 cm in diameter.	3/3/09 high occlusion of the vagina	3/23/09 cystoscopy the right ureter protrudes into the bladder. The left ureteral orifice lies in a deep recess. A large scar devoid of blood vessels is situated behind the fistula.	Cured	
2	St J 48	Carcinoma of the cervix. Radical abdominal operation with extensive resection of the bladder musculature June 1, 1911.	Discharged cured 6/18/11, at home became wet, was readmitted into the hospital with vesicovaginal fistula 1 1/9/12.	1/23/13 high occlusion of the vagina		2/24/12 cured	
3	S A 53	Carcinoma of the cervix. Radical abdominal operation 2/15/13. A portion of the bladder 1 1/2 cm in diameter resected.	2/25/13 patient wet, shreds hanging out of the bladder.	5/23/13 high occlusion of the vagina	7/13/13 cystoscopy there is a diverticulum containing an incarcerated mass ligature, removed endovaginally. A few vessels pass over to the bottom of the diverticulum.	8/4/13 cured	11/13/13 died of cancer
4	M M 54	Carcinoma of the cervix. Radical abdominal operation 9/11/14.	9/28/14 vesicovaginal fistula the size of a quarter, from which gangrenous shreds hang into the vagina.	11/4/14 high occlusion of the vagina	11/16/16 cystoscopy. Diverticulum containing concretions of various sizes, which were removed under guidance of the cystoscope.	12/8/14 cured	
5	A E 61	Carcinoma of the cervix. Radical abdominal operation 11/9/14.	1/12/16 gangrenous cystitis 1/19/16 vesicovaginal fistula 1 1/2 cm in diameter.	3/16/16 high occlusion of the vagina		4/3/16 cured	
6	S M 19	Carcinoma of the cervix. Radical abdominal operation 3/15/16. Bladder adherent.	3/20/16 wet, complicated course 6/14/16 vesicovaginal fistula.	8/17/16 high occlusion of the vagina	9/13/16 residual fistula, entered 9/20/16 wet only when the bladder is full. Dry two to three hours at a time.	9/20/16 discharged improved	
7	K A 54	Carcinoma of the cervix. Radical abdominal operation 7/7/17. Injury of the bladder musculature (technical mistake).	7/14/17 wet, vesicovaginal fistula 9/12/18 nephrectomy because of kidney infection 7/2/19 the fistula persists, an oval defect 1 cm long.	7/2/19 high occlusion of the vagina		7/20/19 cured	2/13/23 carcinoma recurrence
8	R A 61	Carcinoma of the cervix. Radical abdominal operation 8/4/19. Difficult separation of the bladder.	8/9/19 gangrenous cystitis 8/16/19 sloughing off of gangrenous bladder wall, vesicovaginal fistula.	11/14/19 high occlusion of the vagina	Slight urethral incontinence.	4/19/20 cured	
9	II T 53	Carcinoma of the cervix. Radical abdominal operation 12/27/14.	1/15 wet 2/1/15 right-sided ureteral fistula present 11/6/19 readmission with vesicovaginal fistula.	11/18/19 high occlusion of the vagina. Wounding of the bladder neck.	3/2/20 original fistula cured. At the location of the bladder wound, a fistula the diameter of a lead pencil. Slight loss of urine 4/1/20 removal of right kidney because of infection.	Not cured	11/15/20 died Cystitis, left pyelitis
10	II B 45	Carcinoma of the cervix. Radical abdominal operation 12/7/20. Involvement of the bladder by neoplasia.	12/14/20 wet, 3/31/21 broad communication between bladder and vagina.	5/13/21 high occlusion of the vagina		6/12/21 cured	10/20/21 carcinoma of the bladder 2/13/22 died of recurrence of carcinoma
11	A II 45	Carcinoma of the cervix. Radical abdominal operation 6/28/22.	7/3/22 wet, gangrenous shreds come from the vagina 7/5/22 vesicovaginal fistula.	9/16/22 high occlusion of the vagina	9/25/22 dry 10/4/22 cystoscopy showed a diverticulum behind the enormous fistula. A small stone lay within it—passed spontaneously.	11/3/22 cured	1/10/25 pus in the urine. Cystoscopy showed pus coming from both ureters. Bladder normal. Died 10/25 of carcinoma and pyelonephritis

12	P. K. 63	Carcinoma of the cervix. 1/31/22 radical abdominal operation	2/13/22 vesicovaginal fistula. 4/22/22 dry; discharged cured. 6/25/22 readmission with vesicovaginal fistula. 9/19/22 vesicovaginal fistula made larger	10/25/22 high occlusion of the vagina	10/25/22 high occlusion of the vagina	12/4/22 discharged cured	1933 well
13	K. A. 35	Carcinoma of the cervix. 12/10/23 radical abdominal operation following x-ray and radium treatment	1/4/24 wet. 1/24/24 large vesicovaginal fistula. 2/21/24 fistula 1 cm. in diameter	4/1/24 high occlusion of the vagina	4/1/24 high occlusion of the vagina	4/16/24 cured	10/7/24 nephritis. 4/16/25 died with bilateral pyelonephritis. Ureteral fistula on the right side
14	N. O. 34	Carcinoma of the cervix. Bullous edema of the bladder. 10/8/25 radical abdominal operation. Thin walled ureters in infiltrated tissue	10/16/25 wet. 11/8/25 always less bladder urine. 1/12/26 bladder found empty. 2/18/26 bilateral ureteral fistulae, also narrow vesicovaginal fistula. The latter was dilated to the thickness of a finger	3/30/26 obliteration of the vagina	Small recess as indication of a diverticulum	4/21/26 cured	8/14/28 died of recurrence. Pyelonephritis resulting from involvement of ureters by carcinoma
15	W. N. 55	Advanced carcinoma of the cervix. 7/25/28 radical abdominal operation. Defect of the bladder wall because of involvement, not sutured because of danger to the ureters	9/11/28 vesicovaginal fistula admitting three fingers 11/20/28 diameter of fistula 4 cm.	12/19/28 obliteration of the vagina	1/4/29 fistula closed. Moderate incontinence of urine through urethra. Cystoscopy: no diverticulum. Floor of bladder contains no vessels. Transverse bar representing interureteric ligament. Stones removed endovaginally	2/28/30 fistula closed. Discharged with kidney insufficiency	Died at home soon after discharge
16	B. A. 53	Carcinoma of the cervix. 2/32 radical abdominal operation (performed elsewhere)	Wet soon after operation. 8/1/32 small vesicovaginal fistula	10/20/32 obliteration of the vagina	Small hiatus as indication of a diverticulum	11/15/32 cured	
17	N. A. 64	Carcinoma of the cervix. 10/19/32 radical vaginal operation. Injury to bladder musculature during separation	10/28/32 wet. Opening between bladder and vagina. 12/3/32 Vesicovaginal fistula measuring 1½ cm. sagittally	4/6/33 obliteration of the vagina	4/18/32 cystoscopy: a concretion the size of a nut, turned about a silk ligature used at the original radical operation. This was removed endovaginally	5/6/33 cured	No recess. Slight urethral incontinence
18	B. M. 58	Carcinoma of the cervix. 1/4/33 radical abdominal operation	4/12/33 urine escapes from vagina. Ureteral fistula. 4/13/33 bilateral ureteral fistulae. Bladder almost empty. 5/11/33 200 cc. of urine in bladder. 6/5/33 function of ureter not demonstrable. 9/20/33 on the left side good ureteral function demonstrated. 10/14/33 artificial vesicovaginal fistula	12/14/33 obliteration of the vagina (with preservation of a mucous membrane connection between right ureter and the vesicovaginal fistula)	12/27/33 cystoscopy: above the interureteric ligament is a deep fold. Deep blue urine in good flow from left ureter. Right ureter orifice functionless. From the right side a light blue stream of urine	12/30/33 cured	
19	S. M. 72	Carcinoma of the cervix. 6/6/33 radical abdominal operation. Carcinomatous glands left behind	6/13/33 gangrene of the vagina. 6/15/33 putrid cystitis. Fistula of right ureter. 7/27/33 spontaneous closure of ureter fistula. Right kidney functionless. Function of left kidney normal. 1/18/34 ureteral fistula open again. 2/10/34 artificial vesicovaginal fistula	4/3/34 obliteration of the vagina	4/21/34 cystoscopy: good eversion of blue on the left side. The right ureter functionless. The right ureteral fistula (visible within a recess) may be entered with a catheter	5/12/34 cured	End result of cancer unknown
20	M. M. 75	Carcinoma of the body of the uterus. 2/8/17 vaginal hysterectomy	2/15/17 wet. 2/25/17 vesicovaginal fistula the size of a nickel	3/23/17 high occlusion of the vagina	4/21/17 cystoscopy: lat diverticulum. Silk ligature and white mineral fragments removed by irrigation	4/26/17 discharged cured	

TABLE I (Continued)

No.	Name, Age	Basic Disease, Original Operation	Formation of the Fistula	Operation	Further Observations	Result	Remarks
21	R. E. 56	Carcinoma of the body of the uterus. 2/22/33 vaginal hysterectomy (performed elsewhere)	Wet on the fifth day postoperatively. 3/6/33 vesicovaginal fistula. Left ureter fistula. 3/29/33 vesicovaginal fistula, the diameter of a sound. Left sided ureteral fistula cured, with persistence of function	11/29/33 high obliteration of the vagina	12/13/33 in the region of the interureteric ligament there is a transverse retracted fold. On the left side there are two ureteral orifices	12/18/33 discharged cured	
22	D. J. 43	Myoma uteri operated elsewhere vaginally in 1920	Became wet at once. 11/24/20 vesicovaginal fistula	12/2/20 high oelution of the vagina	12/15/20 hair-like residual fistula—cauterized	1/8/21 discharged cured	
23	S. M. 47	Myoma uteri. Vaginal hysterectomy 12/4/25 (performed elsewhere)	Vesicovaginal fistula following the operation. September, 1926, fistula operation by the same operator without success. 4/10/27 fistula the size of a pea. Urine alkaline. Medication prescribed	4/26/27 flap-splitting operation and suture	5/10/27 discharged cured. 10/26/27 wet during past few weeks. Fistula the diameter of a sound. 12/2/27 <i>bigb obliteration of the vagina</i>	11/10/27 discharged definitely cured	
24	J. B. 37	Myoma uteri. 6/21/27 abdominal hysterectomy (performed elsewhere)	Immediately after operation, became wet. 1/5/28 vesicovaginal fistula $\frac{3}{8}$ cm. in diameter	1/20/28 high obliteration of the vagina	.....	2/1/28 discharged cured	12/31/32 cystoscopy: only a sickle-shaped fold
25	L. A. 40	Myoma uteri. 3/24/31 radical abdominal operation (performed elsewhere)	Immediately after operation, became wet. 5/7/31 vesicovaginal fistula admitting the finger tip. Because of eczema and furunculosis, patient was kept in Hebra's water-bed	6/25/31 high obliteration of the vagina	7/9/31 cystoscopy: quite shallow recess	7/16/31 discharged cured	
26	R. B. 51	Myoma uteri. 11/24/32 vaginal hysterectomy (performed elsewhere)	11/28/32 wet. 2/28/33 admitted with vesicovaginal fistula	2/22/33 high obliteration of the vagina	No recess	3/21/33 discharged cured	
27	B. A. 57	Myoma uteri and ovarian cyst. 1/20/33 radical abdominal operation (elsewhere)	Wet immediately after operation. 2/10/33 admitted with vesicovaginal fistula measuring $3\frac{1}{2}$ cm. transversely. 3/8/33 fistula much narrowed	3/24/33 high obliteration of the vagina	Shallow recess	4/12/33 discharged cured	
28	H. M. 48	Myoma uteri. Laparotomy March 1932 (elsewhere)	Wet soon after operation. 5/27/32 unsuccessful operation by original operator. 6/13/33 admitted with small fistula at the end of the vaginal funnel	6/10/33 high obliteration of the vagina	Shallow retraction at the location of the fistula	7/4/33 discharged cured	
29	L. H. 39	Myoma uteri. 7/3/37 abdominal hysterectomy (performed elsewhere)	Vesicovaginal fistula appeared on the third postoperative day. Chemical cauterization unsuccessful. 1/20/38 admission. Endovaginal diathermy unsuccessful. 2/8/38 fistula the caliber of a lead pencil at the top of the vaginal vault	2/12/38 high obliteration of the vagina	.....	2/26/38 discharged cured	na
30	W. A. 40	Ovarian cyst. 7/18/32 abdominal hysterectomy (elsewhere)	8/8/32 vesicovaginal fistula	12/20/32 high obliteration of the vagina	Radiating scar	1/3/33 discharged cured	
31	F. P.	Bilateral tuberculous pyosalpinx, with inguinal fistula. 1/18/11 drained vaginally	1/28/11 fluid resembling urine comes from the drain (pressure necrosis of the bladder) 7/25/11 radical abdominal operation	1/27/12 high oelution of the vagina	12/9/12 cystoscopy: above the left ureteral orifice is a small diverticulum	2/15/12 discharged cured	

Another suprapubic fistula operation which may be cited is the transvesical transperitoneal method suggested by Leg-

uality of their own as was stressed by Bandl<sup>4</sup> as far back as 1877. If in spite of this, many authors (Marion,<sup>37</sup> André

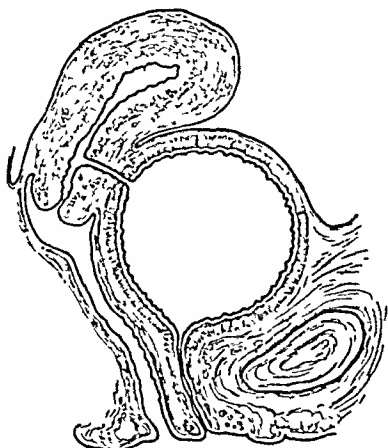


FIG. 6. Diagrammatic sketch of vesicocervical fistula.



FIG. 7. Diagrammatic sketch of Dittel's explanation.

ueu<sup>32</sup> in 1913, a combination of the Trendelenburg with the Dittel operation in which the bladder is opened by a sagittal incision by way of the peritoneal cavity, the incision being extended to the fistula. Separation of the vagina from the bladder and their individual suturing are next performed. The method is very ingenious and effective. Nevertheless, the danger of peritoneal infection is associated with it as it is with Dittel's operation. Although the partisans of the transperitoneal methods are inclined to underestimate this danger (Zweifel,<sup>65</sup> Koster,<sup>29</sup> Legueu<sup>32</sup>), nevertheless the statistics of prominent fistula operators shows a different picture. Legueu himself recorded one fatality from peritonitis among fifty-seven transperitoneal operations. Franz<sup>18</sup> reported fifty-seven fistula operations by various methods with two deaths following transperitoneal operations. Reichenmiller<sup>42</sup> of the Tübingen Clinic had two fatalities in fifteen transperitoneal operations.

This relatively high mortality from transperitoneal fistula operations as well as the technical difficulty of the other suprapubic methods should argue in favor of the vaginal approach since vaginal fistula operations have really no mor-

et Grandineau,<sup>2</sup> Tavildarow,<sup>56</sup> Farman and Thompson,<sup>16</sup> Kelly,<sup>23</sup> Nicholson,<sup>40</sup> Kroiss,<sup>10</sup> Aldridge<sup>1</sup>) give preference to the suprapubic route for postoperative fistulas, it can only be the difficulty of mobilizing the bladder and the danger to the ureters which influences their decision as inaccessibility of vesicovaginal fistulas can always be overcome by an auxiliary vaginal incision.

However, if one does not adhere obstinately to the mobilization of the bladder technic but chooses a procedure which entirely avoids the ureters, even postoperative fistulas after radical operation of cervical cancer, may also be cured without difficulty by the vaginal route. The procedure which we most strongly recommend on the basis of our experience is a modification of Simon's<sup>49-52</sup> colpocleisis. Simon stressed the necessity of applying the transverse closure of the vagina *immediately beneath* the defect. His followers (Ulrich,<sup>58</sup> Menczel,<sup>38</sup> Winckel<sup>61</sup>) have also stressed this necessity. The technic used consisted, therefore, in the circular denudation of the vagina "at a place situated next to the defect" and the suturing of the wound surfaces by means of sagittally applied stitches—a transverse

TABLE II  
POSTOPERATIVE VESICOVAGINAL FISTULAS  
(Operated upon by the usual methods)

No	Name, Age	Basic Disease, Original Operation	Formation of the Fistula	Operation	Further Observations	Result	Remarks
32	L A 67	Carcinoma of the vagina 6/19/26 radical vaginal operation Injury to the bladder, sutured	6/29/26 rectovaginal fistula 7/4/26 vesicovaginal fistula	10/22/26 closure of the rectovaginal fistula Mobilization of the bladder and suture	11/24/26 freed stones removed endovaginally 12/18/26 hair-like fistula into the rectum Vesicovaginal fistula about $\frac{1}{2}$ cm in diameter	3/2/27 because of senile marasmus, patient was discharged not cured to enter home for incurables	
33	P M 46	Carcinoma of the cervix Vaginal hysterectomy in 1930 (elsewhere)	Vesicovaginal fistula during convalescence One attempt at operation by the same surgeon, a second at a University clinic, both unsuccessful 4/25/33 admitted to the hospital Anteriorly and posteriorly there is a strip of vaginal mucous membrane the breadth of a finger On each side there are a number of plaques the size of a quarter with a greyish surface (radium ulcers) Inoperable vesicovaginal fistula	5/17/33 implantation of the right ureter by Coffey's method 7/5/33 implantation of the left ureter (Coffey's method)	7/21/33 feels well Can retain urine for three hours	7/22/33 discharged cured	
34	T A 46	9/8/17 erroneous diagnosis cervical cancer Abdominal radical hysterectomy begun, injury to the bladder sutured, radical operation given up Abdomen closed Vaginal amputation of the cervix (elsewhere)	During convalescence vesicovaginal fistula 1/15/18 admitted 3/18/18 supposing the original diagnosis to be right abdominal, radical hysterectomy Result of microsurgical examination Tuberculosis of the removed lymphatic glands	2/18/18 in the course of the abdominal, radical hysterectomy suture of the fistula secundum Dittel	3/11/18 small vesicovaginal fistula 6/28/18 right pyelotomy because of severe pyelitis	8/16/18 + Postnortem bilateral pyelonephritis, gangrenous cystitis	
35	S L 41	Myoma uteri 5/12/11 abdominal hysterectomy Bladder injury, ureter implantation (elsewhere)	7/30/12 admitted with vesicovaginal fistula	8/6/12 incision about the fistula, freshening of the edges, suture		8/21/12 discharged cured	
36	W M 51	Myoma uteri June, 1926 vaginal hysterectomy (elsewhere)	Wet on the fourteenth postoperative day 9/24/26 admitted with vesicovaginal fistula	10/8/26 plastic with a flap from the posterior vaginal wall	10/21/26 cystoscopy there is a recess at the location of the fistula	11/8/26 discharged cured	
37	J L 53	Myoma uteri 6/12/29 vaginal hysterectomy (elsewhere)	Rectovaginal fistula during convalescence Repeated operations by different surgeons were unsuccessful 9/4/30 after a ligature came away, vesicovaginal fistula appeared After another unsuccessful operation the patient was admitted to the hospital 4/13/31 with rectovaginal and vesicovaginal fistulae	6/25/31 closure of the high rectovaginal fistula through laparotomy Endovaginal high frequency cauterization of the vesicovaginal fistula	12/12/31 occasional traces of fluid stool through the vagina	12/12/31 discharged with healed vesicovaginal fistula	Urine is clear, acid, containing very few fecal particles

TABLE II (Continued)

No.	Name, Age	Basic Disease, Original Operation	Formation of the Fistula	Operation	Further Observations	Result	Remarks
38	S. A. 41	Myoma uteri. 5/5/30 vaginal enucleation and interposition (elsewhere)	5/11/30 wet. Three fistula operations by the original operator were unsuccessful, as were ten fulguration treatments. 3/7/31 vesicovaginal fistula demonstrated on admission to the hospital	3/18/31 mobilization of the bladder, suture, separation of the uterus and new interposition		4/10/31 discharged cured	
39	R. T. 38	Myoma uteri. 10/27/32 attempt at vaginal operation interrupted because of injury to the bladder (elsewhere)	11/29/32 admitted with vesicovaginal fistula	12/20/32 extensive mobilization of the bladder and suture peritoneal covering		1/12/33 discharged cured	
40	K. A. 35	In Russia, a series of operations with bladder injury	Two unsuccessful attempts at closing the fistula, in Russia. 12/7/19 vesicovaginal fistula. The uterus present	12/10/18 incision about the fistula, freshening of the edges, suture		12/31/18 discharged cured	
41	A. G. 50	Dermoid cyst. 3/30/03 oophorectomy (elsewhere)	Bladder difficulty since the operation. 1/12/13 suprapubic fistula (elsewhere). Continued loss of urine by vagina. 1/12/23 vesicovaginal fistula demonstrated	2/5/23 incision about the fistula, freshening of the edges, suture	Incontinence continued for some time	5/17/23 discharged cured	
42	F. W. 26	Bilateral adnecial disease. Radical abdominal operation in the summer of 1932 (elsewhere)	On the seventh postoperative day, vesicovaginal fistula. October, 1932, operation at the same clinic unsuccessful. 1/23/33 admitted with a vesicovaginal fistula	1/26/33 flap-splitting and suture		2/25/33 discharged cured	
43	K. F. 68	Vaginal plastic 28 years before (elsewhere)	During convalescence vesicovaginal fistula appeared. A fistula operation four years later was only partially successful. 10/29/28 vesicovaginal fistula demonstrated	11/9/28 mobilization of the bladder and suture (Wolkowitch)		12/15/28 discharged cured	
44	J. L. 49	June, 1931 colporrhaphy (elsewhere)	12/8/31 wet since the beginning of October. A hair-like fistula demonstrated. Cauterization by silver nitrate unsuccessful	1/20/32 flap-splitting, suture urethroplasty		2/3/32 discharged cured	3/20/32 cystoscopy: there is a recess behind the interureteric ligament representing the operated fistula
45	B. R. 68	Elongation of the cervix. 10/4/24 amputation of the cervix	10/14/24 suture line covered by necrotic tissue. 10/16/24 wet. 10/20/24 vesicovaginal fistula	1/20/25 bladder mobilization and suture	2/6/25 cystoscopy: a retraction formed like a navel at the place of the operated fistula	2/7/25 discharged cured	
46	P. J. 36	Vaginal cyst. 4/30/31 expiration (elsewhere)	Always wet during convalescence. 2/8/32 vesicovaginal fistula	2/9/32 flap-splitting and suture	...	2/27/32 discharged cured	

closure. (Fig. 8.) The diverticulum which inevitably forms as a result of this procedure is a relatively small one and the lower portion of the vagina, which is not closed off, is in most cases adequate for cohabitation. Technically, this method was simple and was very successful because the anterior and posterior vaginal walls are normally in contact so that all tension on the suture line was avoided.

Simon reported good results with his "occlusio vaginae" in obstetrical fistulas. In forty-two vesicovaginal fistulas he performed colpocleisis twelve times with twelve cures. Stone formation occurred in only one case. However, the excellent results which Sims,<sup>53</sup> Bozemann<sup>7</sup> and Salzer<sup>45</sup> had already achieved at that time without the necessity of resorting to colpocleisis made the application of this procedure seem superfluous if not technically wrong. For even if one were successful in keeping the diverticulum as small as possible, the flow of menstrual blood and of the various cervical and uterine secretions into the bladder often caused severe cystitis and even formation of concretions. As a matter of fact, colpocleisis has been subjected to extraordinarily severe adverse criticism by eminent individuals. Emmet,<sup>13</sup> on the basis of his experience derived from the imposing material of 400 vesicovaginal fistulas, considered himself justified in the statement that there was no greater blunder in surgery than the Simon operation. In recent years all modern authors have regarded this procedure as obsolete and have removed it from the list of fistula operation (Miller).<sup>39</sup>

However, colpocleisis following total extirpation of the uterus must be evaluated entirely differently from colpocleisis for obstetrical fistulas. Fritsch<sup>19</sup> designated the "high colpocleisis," that is, Simon's operation, as a useful procedure in the absence of the uterus; we have performed this operation regularly with this prerequisite since 1909 (Case 1). In 1913, the author<sup>31c</sup> recommended this operation as the simplest and surest procedure for vesico-

vaginal fistulas following hysterectomy and pointed out its advantages in repeated communications. Wertheim joined in this recommendation in a subsequent discussion. In 1926, the author modified Simon's procedure in such a manner that the diverticulum formation, previously unavoidable, has been entirely eliminated and the transverse closure of the vagina divested of its dangers.

#### TECHNIC OF THE PROCEDURE

The lithotomy position is used. If the fistula is inaccessible, an episiotomy or Schuchardt's incision is made to expose the fistula. Owing to the anatomy of the parts, the upper or posterior edge of the fistula always coincides with the transverse firm scar in the vault of the vagina. (Fig. 4.) A circular area of vaginal mucosa is denuded from both the anterior and posterior vaginal walls for a distance of  $1\frac{1}{2}$  cm. from the fistula opening, thus removing all vaginal mucosa up to the opening of the fistula. (Figs. 9 and 10.)

*No vaginal mucous membrane is allowed to remain between the edges of the incision and the fistulous opening.*

Sagittal sutures are now placed from above downward to coapt the raw surfaces on either side of the fistulous opening. (Fig. 11.) This is the only difficult part of the procedure as the lateral denuded areas often retract as a result of the pull of the scar. The posterior portion of the fistula is now closed. (Fig. 12.) The remaining segment disappears after tying the second row of sagittally placed sutures. (Fig. 13.) Closure of the anterior and posterior margins of the vaginal wound terminates the operation. The suture material used is plain catgut throughout.

While in the Simon's high occlusion operation a diverticulum must of necessity be formed, in the procedure here described only a shallow niche is left even in the most unfavorable cases. A comparison of Figures 3 and 14 will make this clear. In Figure 3 (high occlusion) the cystoscopic picture of the vesicovaginal

FIG. 8.

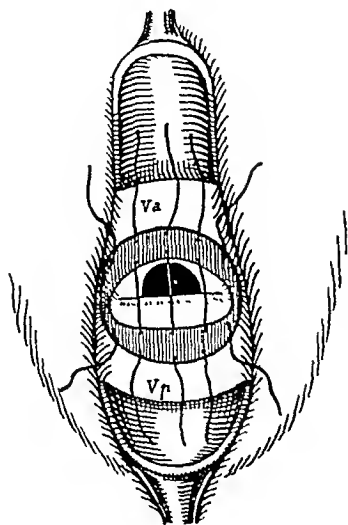


FIG. 9.

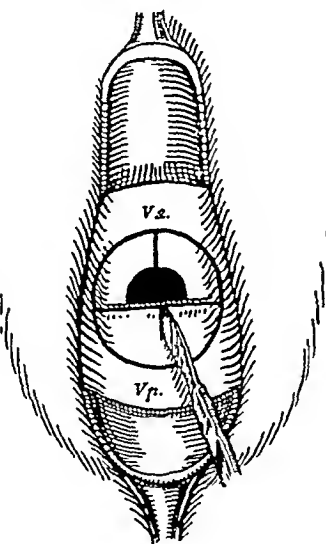


FIG. 10.

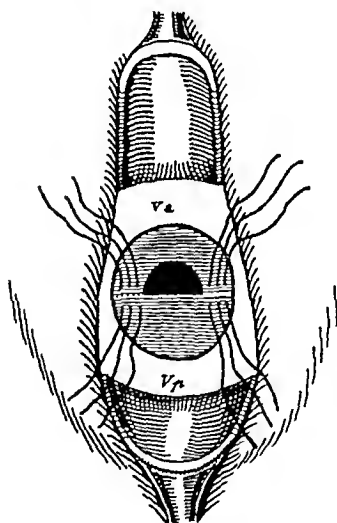
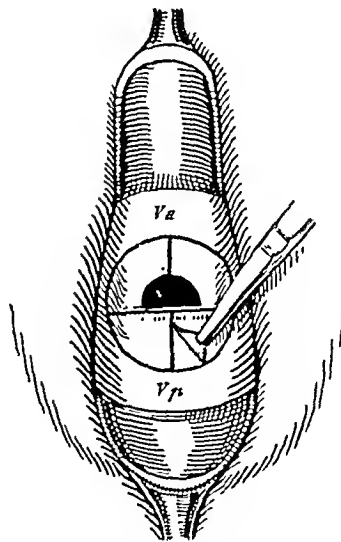


FIG. 11.

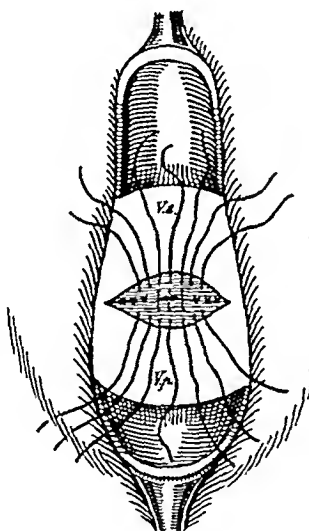


FIG. 12.

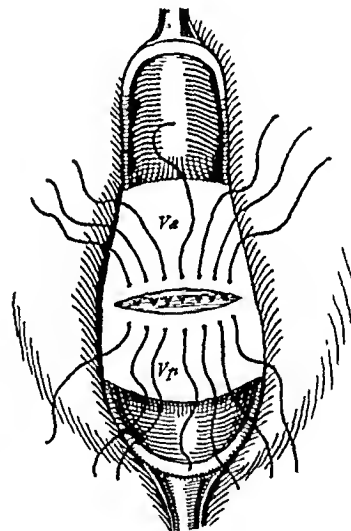


FIG. 13.

FIG. 8. Simon's colpocleisis. V.a., anterior vaginal wall; V.p. posterior vaginal wall. A ring of vaginal mucosa is denuded and sutured leaving an area of vaginal mucosa close to the fistula which becomes a diverticulum of the bladder.

FIG. 9. Diagrammatic representation of the first step in the obliteration operation. A circular area of vaginal mucosa is denuded for a distance of 1½ cm. from the fistula opening.

FIG. 10. Diagrammatic sketch showing denudation carried out in four quadrants. No vaginal mucosa is allowed to remain between the edges of the incision and the fistulous opening.

FIG. 11. Drawing showing raw surfaces on both sides of the fistula—united by sagittal sutures, bringing fistulous opening in contact with the posterior vaginal wall.

FIG. 12. First layer of sutures tied, second layer of sagittal sutures inserted closing fistulous opening and bringing raw surface of bladder in contact with anterior wall of rectum.

FIG. 13. Closure of margins of the vaginal wound.

fistula is the same as before operation. The inferior margin of the fistula into which the right ureter opened was formed

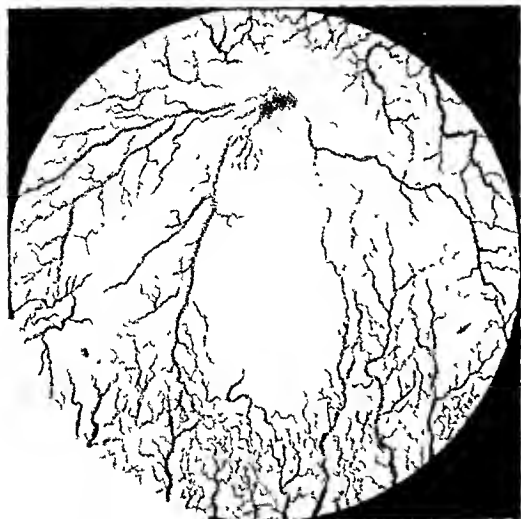


FIG. 14. Cystoscopic picture of the bladder after the obliteration operation. No diverticulum is seen as in Fig. 3, only a small niche. Both ureter openings are visualized.

by the muscular prominence of the inter-ureteric ligament. In the shadow, the bottom of the diverticulum is distinctly recognizable as the posterior wall of the vagina, which is clearly distinguishable from the bladder mucous membrane.\*

Following the operation here described, there remains instead of a diverticulum a flat white scar which terminates in a small niche. (Fig. 14.)

In the thirty-one cases of postoperative vesicovaginal fistulas, in which obliteration or occlusion of the vaginal vault was performed there were two failures: One occurred as a result of a serious technical error on the part of an inexperienced operator (Case 9). One fistula was very much improved (Case 6). *All of the remaining twenty-nine patients were cured by a single operation.* In only one of these cases was it found necessary to cauterize a narrow residual fistula with silver nitrate.

In the first sixteen cases of this series the

\*The assertion by Emge, (1937) that "Vaginal mucosa transferred into the bladder soon becomes indistinguishable" (explained by the embryological relationship between the vaginal and bladder tissues) could not be substantiated in numerous observations.

original Simon's operation was performed and concretions formed in four, while among the fifteen vaginal vault obliteration operations concretions occurred only twice. Little emphasis should be placed on this difference owing to the smallness of the series. Concretions are not uncommon after all fistula operations (Jacoby,<sup>26</sup> Ruebsamen,<sup>43</sup> Heckenbach<sup>24</sup>). More significant, however, is the fact that these secondary concretions are extraordinarily soft, easily crushed and may be broken up and extracted under guidance of the cystoscope. (Latzko.<sup>31a</sup>)

It may be worthwhile to emphasize the fact that a recurrence of stones was not observed in any of our cases. With adequate treatment and acidification of the urine, the tendency for the repeated development of cystitis and urinary infections, which is said to be the consequence of real and false diverticula, did not manifest itself.

In spite of the good results which we have achieved with the obliteration operation, we are by no means inclined to represent it as the only method of operation for postoperative fistulas. In Cases 32 to 46 of our statistics, we used most of the other methods of fistula operation: simple denudation and suture, flap splitting, extensive mobilization of the bladder, attachment of other tissues, Dittel's suprapubic method, ureter transplantation by Coffey's method, etc., according to the specific indications.

We must not fail to mention that among thirty-eight postoperative fistulas, whose formation and course could be observed by us, nine or 23.5 per cent healed spontaneously. The time required for healing varied between seventeen days and three months. No essential difference was observed with reference to the healing tendency and the time required for healing between fistulas caused by accidental or intentional bladder wounds and those due to gangrene.

When spontaneous healing can no longer be expected, we consider obliteration the

simplest and most successful operation for fistulas following hysterectomy. Nevertheless, the following conditions must be

the first condition have been discussed. Condition No. 2 may be ignored only in the case of very old women or after complete

TABLE III  
POSTOPERATIVE VESICOVAGINAL FISTULA—SPONTANEOUS CURE

No.	Name, Age	Basic Disease, Original Operation	Formation of the Fistula	Further Observations	Result	Remarks
47	R. B. 52	Carcinoma of the cervix. 7/16/15 radical abdominal operation	7/17/15 wet; vesicovaginal fistula	10/19/15 fistula closed spontaneously	10/28/15 vesicovaginal fistula cured	Nephrectomy advised because of left-sided ureteral fistula
48	S. M. 45	Carcinoma of the cervix. 10/6/15 radical abdominal operation. Bladder resection and suture	10/22/15 vesicovaginal fistula the size of a nickel	Short time after release from the hospital, fistula closed spontaneously	12/6/15 discharged with a fistula	8/12/24 well
49	F. Th. 40	Carcinoma of the cervix. 9/26/19 radical abdominal operation	10/8/19 vesicovaginal fistula	11/4/19 dry. Fistula closed spontaneously	11/25/19 cured	1/31/20 readmission in coma. 2/1/20 died. Residual carcinoma and pulmonary gangrene
50	B. M. 28	Carcinoma of the cervix. 6/10/20 radical abdominal operation	6/15/20 urine bloody. 6/21/20 vesicovaginal fistula	8/20/20 dry for the past two days. 9/2/20 fistula closed spontaneously	10/13/20 cured	4/17/21 died of recurrence
51	P. A. 47	Carcinoma of the cervix. 11/10/22 radical abdominal operation. Difficult separation of the bladder	11/28/22 wet; vesicovaginal fistula	8/25/24 dry. Fistula closed spontaneously	9/20/24 cured	
52	U. L. 28	Carcinoma of the cervix. 7/25/24 radical abdominal operation. Bladder highly fixed	7/31/24 wet; 8/5/24 vesicovaginal fistula	8/25 1924 dry	9/20/24 cured	2/11/25 concretions removed by endovesical way. 2/19/25 cured
53	T. D. 39	Carcinoma of the sigmoid flexure. 11/13/27 laparotomy. Extraperitonealization of the tumor. Encroachment of tumor on the bladder. Resection of the bladder wall which was infiltrated to the thickness of a finger. No suture of the bladder. Hysterectomy	Bladder drained vaginally	11/29/27 removal of the tumor which had been brought out of the abdomen. Dry at end of December. Fistula closed	March, 1928 discharged cured	May, 1933 free of recurrences. Normal bladder function
54	S. F. 53	Ovarian cyst and hydrosalpinx. 6/5/18 radical abdominal operation. Injury to the bladder, sutured	6/8/15 wet; vesicovaginal fistula	7/11/15 fistula closed spontaneously	Discharged cured	
55	S. R. 32	Pyosalpinx 1/14/25 radical abdominal operation	2/1/25 considerable bleeding from the bladder. Vesicovaginal fistula	2/11/25 dry, fistula closed spontaneously	Discharged cured	

fulfilled if the operation is to be successful: (1) Previous *total* hysterectomy; (2) adequate length of the vagina, in order to be sure of an organ fit for cohabitation after the loss of at least 1.5 cm.; (3) situation of the fistula at the outermost end of the vaginal funnel so that the posterior margin of the fistula and the scar of closure of the vaginal vault coincide. The reasons for

explanation of this fact to the patient. Point 3 is of decisive importance.

The correct performance of the obliteration operation is only possible under the special conditions emphasized here; and in the absence of these conditions, one of the usual methods of fistula operation may be carried out. In cases of vesicovaginal fistula associated with rectovaginal

TABLE IV

POSTOPERATIVE VESICOVAGINAL FISTULAS—PATIENTS LEFT THE HOSPITAL UNOPERATED UPON

No.	Name Age	Basic Disease, Original Operation	Formation of the Fistula	Further Observations	Result	Remarks
56	G. A. 54	Carcinoma of the cervix. 1/3/17 radical abdominal operation. Separation of the bladder difficult. Exposure of the mucous membrane	1/8/17 wet; vesicovaginal fistula	.....	4/4/17 discharged. Occlusion operation advised	Did not return
57	K. A. 59	Carcinoma of the cervix. 1/27/19 radical abdominal operation	2/4/19 indwelling catheter because of incontinence. 3/21/19 wet. 4/9/19 vesicovaginal fistula	.....	5/1/19 discharged uncured	Refused operation
58	B. J. 42	Carcinoma of the cervix. 11/25/21 radical abdominal operation. Infiltration of the bladder wall	11/30/21 bloody urine passed through the vagina	.....	12/7/21 died. Autopsy showed duodenal ulcer with intestinal hemorrhage	Dead of intercurrent disease
59	D. J. 46	Carcinoma of the cervix. 7/9/23 radical abdominal operation. Reoperation because of secondary hemorrhage. Resuture of the vaginal wall	7/10/23 wet (obvious bladder injury). 7/16/23 vesicovaginal fistula	.....	8/16/23 died. Autopsy showed phlegmon of the pelvic connective tissue	Dead as a consequence of the original operation
60	S. M. 48	Carcinoma of the cervix. 11/4/24 radical abdominal operation (performed elsewhere)	11/7/24 wet. 11/15/24 vesicovaginal fistula	12/6/24 for some time has been dry, even when the bladder was not emptied for a number of hours. 1/6/25 readmission with vesicovaginal fistula	1/20/25 discharged almost dry. Directed to return for followup	Did not come back
61	S. G.	Carcinoma of the cervix. 6/30/25 radical abdominal operation. Resection of the bladder musculature	7/1/25 wet. 9/11/25 vesicovaginal fistula	.....	9/9/25 scarcely wet. Discharged, to be treated ambulatorily	Did not return
62	M. M. 37	Carcinoma of the cervix. 2/22/26 radical abdominal operation	3/1/26 escape of urine through the vagina. Bladder empty. Bilateral ureteral fistula. 5/4/26 creation of an artificial vesicovaginal fistula to make possible an occlusion operation later	Increasing marasmus	8/9/26 died. At autopsy bilateral cystitis, and pyelonephritis. Necrosis of the renal pyramids	Closure of the fistula was contraindicated because of the bad condition of the patient
63	E. L. 43	Carcinoma of the cervix. 3/5/31 radical vaginal operation. Injury to the bladder which was sutured (elsewhere). Postoperative x-ray and radium treatment	6 months after operation there was a vesicovaginal fistula. 9/5/32 fistula operation (elsewhere) without success. 1/4/33 admitted with vesicovaginal and rectovaginal fistula	1/13/33 operation for rectovaginal fistula. 1/25/33 discharged cured. 3/14/33 readmission with inoperable vesicovaginal fistula. Coffey operation which was advised refused by patient	3/30/33 discharged not cured	
64	G. M. 69	2/13/15 radical abdominal operation for carcinoma of the cervix. Postoperative radium treatment. In February 18, 1918 rectovaginal fistula. 3/17/19 fistula operation. After a few months, recurrence of the fistula. Since March, 1930, patient was unable to hold her urine	4/10/30 admitted to the hospital. The vagina is 3 cm. long. At its end is a cloaca from which urine and feces pass: vesico- and rectovaginal fistulas	The chances of cure of radium fistula which appeared after fifteen years are extremely small. Since the patient has come to tolerate the condition, attempt at operative cure was not advised	4/19/30 discharged not cured	
65	G. F. 35	Myoma uteri? 3/6/26 vaginal hysterectomy (elsewhere)	4/5/26 admitted with vesicovaginal fistula	.....	4/8/26 discharged not cured	Recommended operation refused

fistula (Cases 32, 37 and 64) the results were not striking.

### CONCLUSIONS

1. The genesis and therapy of post-operative fistulas are discussed.

2. Obliteration of the vault of the vagina is offered as the simplest and most effective method of cure for postoperative fistulas following total hysterectomy.

3. Thirty-one cases of vesicovaginal fistulas are reported treated by occlusion or obliteration of the vaginal vault. There were twenty-nine cures, one improved and one failure.

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# THE STERILITY OF AMERICAN MADE SURGICAL CATGUT SUTURES

A TWELVE-YEAR STUDY  
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THE comprehensive studies of Bulloch<sup>2</sup> in 1929 on the subject of the disinfection and preparation of catgut for surgical purposes brought to light the inadequacy of the many types of chemical sterilization that had long been employed. The work of Meleney and Chatfield<sup>10</sup> emphasized the need of more efficient methods of testing the sterility of catgut, and they proposed an effective test. The fallacy of chemical sterilization of catgut sutures and the uniform reliability of carefully controlled heat sterilization were demonstrated by the extensive bacteriologic investigations<sup>3-9</sup> during which I perfected and recommended an improved method<sup>7</sup> for determining sterility. In his survey of catgut sutures available on the American market, Brewer<sup>1</sup> checked and approved this method of sterility testing.

The investigations of the sterility of surgical catgut sutures with particular reference to American made catgut, which were initiated in 1930 and the results of which I reported<sup>6</sup> in 1935, have been continued in each of the subsequent years through 1941. The purpose of the continued research on this subject has been to ascertain the annual status of sterility of American made surgical catgut sutures available on the open market, and to report such status as a warning to the surgical profession as well as to the manufacturers of catgut sutures without, of course, disclosing the identity of any brand. The publication of the results for the five-year period, 1930 to 1934 inclusive, aroused widespread interest among the surgical profession as indicated by the many hundreds of letters received from surgeons in all parts of the country. The general approval and support

of this work by these men served as a stimulus to continue the investigation and to conduct a campaign for the purpose of establishing an official control of suture sterility in the United States.

## MATERIALS

At periodic intervals during each year of this twelve-year study, several lots of the various brands of American made catgut sutures were purchased on the open market from surgical supply dealers. Not infrequently it was necessary for them to obtain fresh stock direct from the manufacturers to fill my orders. Hence, the suture materials used in this investigation—as in all my previously reported research—represented products of current and recent manufacture.

TABLE I  
TOTAL QUANTITY TESTED OF FOURTEEN AMERICAN BRANDS OF CATGUT SUTURES

Year	No. of Lots	No. of Sutures	No. of Brands
1930 to 1934	605	6,184	12
1935 to 1941	776	11,202	12*
Total	1,381	17,386	14†

\* Includes ten of the twelve brands tested during 1930 to 1934, together with two new brands.

† Includes the original twelve brands and the two new ones.

In my bacteriologic survey<sup>6</sup> covering the five years from 1930 to 1934 inclusive, 605 lots comprising 6,184 sutures of twelve brands were tested for sterility. Since then, during a period of seven consecutive years from 1935 to 1941 inclusive, 776 lots comprising 11,202 sutures of twelve brands

have been tested. These included ten of the twelve brands previously investigated (Manufacturers G and L were not making sutures during any of the seven years of this later study), together with two new brands which were placed on the market during this seven-year period. The entire survey for the twelve consecutive years, therefore, includes 1,381 lots comprising 17,386 sutures from fourteen American manufacturers. (Table 1.)

#### METHODS

The bacteriologic technic used during the survey of the seven consecutive years, 1935 to 1941 inclusive, is essentially the same as that employed for the five-year investigation during the period of 1930 to 1934 inclusive and was fully described in a previous paper.<sup>7</sup> However, certain modifications have been embodied in the technic in recent years including the use of *Clostridium novyi* in place of *Clostridium sporogenes* for determining the growth-promoting properties of the anaerobic culture medium, and *Escherichia coli* as the control organism whose growth should be supported by the aerobic culture medium.

The technic now includes an additional step which consists of transferring the strand of catgut from the neutralizing fluid, Formula A (1 per cent sodium thiosulfate and 1 per cent sodium carbonate in distilled water), to a test tube containing 40 cc. of sterile distilled water and incubating the tube at 37°C. for twenty-four hours. In this step, the suture is washed free of the neutralizing fluid which otherwise might be carried over into the culture medium, especially in the transfer of large size sutures (Nos. 1, 2, 3, and 4). Hence, this additional step serves a two-fold purpose: first, it eliminates the sodium thiosulfate which might exert a bacteriostatic action, thereby inhibiting bacterial growth; and second, it removes the sodium carbonate which might increase the hydrogen ion concentration of the culture medium to as much as pH 8.4—a degree of alkalinity which tends to prevent growth of some

anaerobes that may be present in the catgut.

In a previous paper<sup>7</sup> in which the details of my bacteriologic technic for testing the sterility of surgical sutures are described, the use of a special neutralizing fluid, Formula B, is recommended. It consists of 10 per cent solution of sodium thiosulfate in distilled water, for removing large amounts of mercury or iodine from sutures. In my studies<sup>4</sup> of the chemical sterilization of catgut, it was demonstrated that the large amount (3½ per cent) of a mercury compound, with which the sutures of one American manufacturer were impregnated, could not be entirely removed with a neutralizing solution of 1 per cent sodium thiosulfate nor even with a 5 per cent solution; but that this could be attained by means of a 10 per cent solution of sodium thiosulfate used as a *preliminary* additional step in the regular technic. That is, the suture is transferred first to a tube containing the special neutralizing fluid, Formula B (10 per cent sodium thiosulfate in distilled water). After incubation at 37°C. for twenty-four hours it is transferred to a tube of sterile distilled water and incubated twenty-four hours, and next the suture is transferred to a tube containing the regular neutralizing fluid, Formula A, consisting of 1 per cent sodium thiosulfate and 1 per cent sodium carbonate in distilled water.

#### SPECIAL NEUTRALIZING FLUID

In his report on the sterility of catgut sutures, Brewer<sup>1</sup> states: "In cases in which large amounts of mercury or iodine are known to be present, Clock<sup>4</sup> suggests using 10 per cent sodium thiosulfate as the neutralizing fluid. He suggests that this be used in addition to the regular technic so that the thiosulfate will be removed by the distilled water, which is the first step in the regular procedure. I am unable to gather from his paper<sup>7</sup> his exact procedure but, presumably, he then puts the suture through one per cent sodium thiosulfate, then to medium. I have found by chemical test that the suture takes up sufficient

thiosulfate from the ten per cent solution and carrying it subsequently through the one per cent solution is not necessary. . . . It has been the policy in the latter part of this survey to place the suture directly into the ten per cent sodium thiosulfate for twenty-four hours, then into distilled water for an additional twenty-four hours and then into the medium. . . . It has been found that the amount of thiosulfate, after the distilled water washing, which may be carried over into the medium is not bacteriostatic."

The paper<sup>7</sup> to which Brewer refers clearly stated the sequence of the steps in the technic, so that there should have been no doubt about the correctness of the order of the procedure.

With regard to the use of the special neutralizing fluid, Formula B (10 per cent sodium thiosulfate in distilled water), Brewer states that it is not necessary to carry the suture subsequently through the regular neutralizing fluid, Formula A (1 per cent sodium thiosulfate and 1 per cent sodium carbonate). Furthermore, he says that the amount of thiosulfate, after the distilled water washing, which may be carried over into the culture medium is not bacteriostatic. During many years' experience with the problem of suture sterility, I have probably used the special neutralizing fluid consisting of 10 per cent sodium thiosulfate in a larger number of sterility tests than any other bacteriologist, and the results of such tests have been repeatedly checked by chemical analyses. This extensive experience lends added weight to my recommendation concerning the manner of using the special neutralizing fluid, Formula B. The reason for recommending the use of 10 per cent sodium thiosulfate as a *preliminary* additional step to the regular technic is very simple. If the technic of Brewer is used—that is, omitting the subsequent incubation in the regular neutralizing fluid, Formula A (1 per cent sodium thiosulfate and 1 per cent sodium carbonate)—the results of testing nonsterile sutures impregnated with  $3\frac{1}{2}$  per cent of a

mercury compound will be as follows: (1) growth of bacteria will be inhibited by the residual amount of mercury which acts as a bacteriostatic agent; (2) chemical analyses of the sutures will reveal that this residue may amount to as much as 0.9 per cent mercury. In my later research, I found that the use of stronger solutions of sodium thiosulfate—up to 15 per cent—will not remove the residual amount of mercury. It is absolutely necessary that the catgut be "cleared" of this residue through the subsequent use of the regular neutralizing fluid, Formula A, which consists of 1 per cent sodium thiosulfate and 1 per cent sodium carbonate.

#### RESULTS

Since the previous investigation<sup>6</sup> during the five-year period of 1930 to 1934 inclusive, four brands of catgut sutures have been discontinued while two new brands have been introduced to the American market. Manufacturer F discontinued the manufacture and sale of sutures in 1937, Manufacturers G and L in 1935, and Manufacturer J in 1941. Sutures of Manufacturers M and N first became available in 1935.

Thus, during the seven-year period from 1935 to 1941, twelve brands of catgut sutures were examined including ten of the original twelve brands tested during 1930 to 1934, together with the sutures of two new brands. The total number of brands of catgut sutures tested during the entire survey of twelve consecutive years was fourteen, including the original twelve brands and the two new ones.

*Results in 1930 to 1934.* The results of sterility tests applied to twelve brands of American made catgut sutures during each of these five years were given in detail in a previous paper.<sup>6</sup> (Tables I and II.)

*Results in 1935.* Tests were applied to 152 lots comprising 2,284 catgut sutures. Eight brands were uniformly sterile, while the four brands of Manufacturers A, E, F and I were found to be nonsterile. (Table II.)

*Results in 1936.* Tests were applied during this year to 112 lots comprising 1,792 catgut sutures. Nine brands were sterile, including the eight brands which were sterile in 1935; while the three brands of Manufacturers A, F and I were found to be nonsterile. These three nonsterile brands were also nonsterile in 1935. (Table II.)

1938 was again found to be nonsterile this year. (Table II.)

*Results in 1940.* Tests were applied during this year to 109 lots comprising 1,488 catgut sutures. Ten brands were sterile, including nine brands which were found sterile in the years 1937, 1938 and 1939; while the sutures of Manufacturer A,

TABLE II

PERCENTAGE OF NONSTERILE LOTS OF CATGUT SUTURES OF THE FOURTEEN AMERICAN BRANDS

Manu- facturer	1930, Per Cent	1931, Per Cent	1932, Per Cent	1933, Per Cent	1934, Per Cent	1935, Per Cent	1936, Per Cent	1937, Per Cent	1938, Per Cent	1939, Per Cent	1940, Per Cent	1941, Per Cent
A	100	50	78	85	91	36	8	0	0	0	15	12
B	0	0	0	0	0	0	0	0	0	0	0	0
C	0	0	0	0	0	0	0	0	0	0	0	0
D	0	0	0	0	0	0	0	0	0	0	0	0
E	20	57	83	0	16	54	0	0	0	0	0	0
F	50	100	88	57	33	22	10	—	—	—	—	—
G	100	42	12	0	25	—	—	—	—	—	—	—
H	0	0	0	0	0	0	0	0	0	0	0	0
I	57	0	28	16	12	28	6	0	0	0	0	0
J	0	33	0	33	0	0	0	0	0	0	0	—
K	0	0	0	0	0	0	0	0	0	0	0	0
L	0	0	0	0	0	—	—	—	—	—	—	—
M	—	—	—	—	—	0	0	25	66	100	0	0
N	—	—	—	—	—	0	0	0	0	0	0	0

0 indicates sterility; — indicates sutures not being manufactured.

*Results in 1937.* This year, 104 lots representing 1,486 catgut sutures were tested. Ten brands were sterile, while the product of Manufacturer M was found to be nonsterile. Eight of the ten sterile brands were also found sterile in 1936, while seven of them were sterile in 1935. (Table II.)

*Results in 1938.* Tests were applied to 94 lots comprising 1,262 catgut sutures. Again, ten brands were sterile, the same ten brands which were found sterile in 1937, while the product of Manufacturer M which was nonsterile in 1937 was again found to be nonsterile this year. (Table II.)

*Results in 1939.* In this year, 114 lots consisting of 1,646 catgut sutures were subjected to tests for sterility. Again, ten brands were sterile, and they were the same ten brands which were found sterile in 1937 and 1938; while the product of Manufacturer M which was nonsterile in 1937 and

which had been sterile over a period of three consecutive years, were found to be nonsterile. (Table II.)

*Results in 1941.* Tests were applied to 91 lots comprising 1,244 catgut sutures. Nine brands were sterile, these being nine of the ten brands which were found sterile in 1940, while the sutures of Manufacturer A were again found to be nonsterile. (Table II.)

## SUMMARY OF RESULTS

*Five-Year Period, 1930 to 1934.* The results of the five-year investigation<sup>6</sup> of the sterility of twelve brands of American made catgut sutures showed that six brands were uniformly sterile during the five consecutive years of 1930 to 1934 inclusive. During this period, the sutures of Manufacturers A and F were found to be nonsterile every

year. The products of Manufacturers E and G were nonsterile in three consecutive years and then, after an interval of one year in which they were sterile, were again found to be nonsterile. One brand, marketed by Manufacturer I, was nonsterile in 1930 and then, after proving to be sterile in 1931, was found nonsterile in the next three consecutive years. The other nonsterile brand, product of Manufacturer J, was found to be nonsterile in two nonconsecutive years. (Table II.)

During the last year (1934) of the five-year investigation, five brands of American made sutures were found to be nonsterile; and they were the same five brands that proved to be nonsterile in the first year (1930) of the survey, namely, sutures of Manufacturers A, E, F, G and I. Therefore, during the five-year period, absolutely no improvement occurred in the status of the sterility of American made catgut sutures; so that the danger of nonsterile sutures which was apparent in 1929 still existed.

*Seven-year Period, 1935 to 1941.* The results of the seven-year survey of the sterility of twelve brands of American made surgical catgut sutures showed that six brands were uniformly sterile during the seven consecutive years of 1935 to 1941 inclusive.

During this seven-year period, the sutures of Manufacturer A, which were found to be nonsterile for two consecutive years (1935 and 1936), proved to be sterile during the next three consecutive years (1937, 1938 and 1939); but these were found to be nonsterile again during the last two consecutive years (1940 and 1941). The sutures of Manufacturer E which were found to be nonsterile in 1935 were sterile during the following six consecutive years. Sutures of Manufacturer F were found to be nonsterile in two consecutive years (1935 and 1936), and in the next year their manufacture was discontinued. The sutures of Manufacturer I were found to be nonsterile in the two consecutive years of 1935 and 1936; but during the next five consecutive years this

brand of catgut sutures was sterile. The sutures of Manufacturer J were sterile during six consecutive years, but their manufacture was discontinued in the final year (1941). The product of Manufacturer M, which was sterile in two consecutive years (1935 and 1936), was found to be nonsterile during the following three consecutive years (1937, 1938 and 1939); and then was again sterile in the last two years of this study (1940 and 1941). (Table II.)

*Twelve-year Period, 1930 to 1941.* This twelve-year study of the sterility of fourteen brands of American made surgical catgut sutures demonstrated that, of the eight brands that were continuously marketed during this period of twelve consecutive years, 1930 to 1941 inclusive, *only five brands* were uniformly sterile and, therefore, safe to use. The sutures of Manufacturer A, after exhibiting improvement during three consecutive years (1937, 1938 and 1939), were found to be nonsterile again in the last two consecutive years. The greatest improvement was shown by the product of Manufacturer E, which was found to be nonsterile in five of the first six years but which was sterile during the past six consecutive years. The sutures of Manufacturer F, which were found to be nonsterile in seven consecutive years, are no longer manufactured. Likewise, the sutures of Manufacturer G, which were found to be nonsterile in four out of five years, are not now manufactured. One brand, marketed by Manufacturer I, was nonsterile in 1930 and then, after proving to be sterile in 1931, was again found to be nonsterile in the next five consecutive years (1932 to 1936 inclusive); but during the following five consecutive years (1937 to 1941 inclusive) the sutures of this manufacturer were sterile. The product of Manufacturer J, which was found to be nonsterile in two nonconsecutive years during the first five years of this survey, was sterile during the following six consecutive years and its manufacture was discontinued in the final year (1941).

## CONCLUSIONS

From this twelve-year survey of the status of the sterility of American made surgical catgut sutures, embracing fourteen different brands and comprising 1,381 lots and a total of 17,386 catgut sutures, the following outstanding facts are important:

1. One manufacturer, who for several years used large amounts of a soluble mercury salt with which to impregnate catgut sutures and who depended upon such chemical treatment for sterilization, continues to impregnate the sutures heavily with mercury. However, heat of a sufficient degree and duration to sterilize is now also used. The physical properties of the sutures also indicate that adequate heat is now used in the sterilization process.

2. The sutures of Manufacturer E which formerly were impregnated with copper salts are now subjected to heat treatment. Apparently, this manufacturer no longer places reliance upon the chemical method of sterilization.

3. The sutures of Manufacturers F and G, which were found to be nonsterile repeatedly over a period of several years, are no longer manufactured. Likewise, the sutures of Manufacturer J, which were intermittently nonsterile during the early years of this investigation, are not now manufactured. Hence, these three sources of possible danger to the hospital and surgical profession have been removed.

4. The sutures of Manufacturer A, however, exhibit a degree of unreliability that is dangerous. For seven consecutive years, the high percentage of nonsterile lots of this brand of sutures indicated that entirely inadequate heat or none whatever was used for sterilization purposes, reliance having been placed upon chemical methods of sterilization. And then, during the next three consecutive years, this brand of sutures showed entire absence of bacterial growth and the sutures possessed certain physical properties characteristic of heat sterilized catgut. But during the last two years (1940 and 1941), this brand of sutures

again was found to be nonsterile, and the physical properties indicate that inadequate heat is being used for the sterilization method.

5. The sutures of Manufacturer M also presented an uncertain condition of sterility. During the first two years (1935 and 1936) these sutures were sterile; in the next three consecutive years (1937, 1938, and 1939) this brand of sutures was found to be nonsterile; and then, for the last two consecutive years (1940 and 1941), they were sterile.

6. The sutures of Manufacturer N proved to be sterile in each of the seven years that they were available on the market (1935 to 1941 inclusive).

7. During the past seven years, there was a progressive improvement in the status of the sterility of American made catgut sutures. An excellent example of this encouraging trend is the product of Manufacturer E which was found to be nonsterile in five of the first six years of this study, but which was sterile during the past six consecutive years (1936 to 1941 inclusive).

8. Of the eight brands of American made surgical catgut sutures that were continuously manufactured and sold on the open market during this period of twelve consecutive years, *only five brands* (products of Manufacturers B, C, D, H and K) were uniformly sterile every year and, therefore, safe to use.

9. As a direct result of the widespread publicity accorded the results of my investigations on suture sterility,<sup>3-9</sup> the improved bacteriologic method which I perfected and which has been accepted by workers everywhere was adopted with certain additional procedures and modifications by the United States Pharmacopoeia XI as the standard technic for "Tests for the Sterility of Solids" which became official on January 1, 1941. This test is now being enforced by the Federal Food and Drug Administration as originally recommended<sup>7</sup> in 1935.

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THE growth and preservation of hair is dependent upon a proper trophic nerve supply. In trigeminal neuralgia, when the frontal branch is involved, the hair may drop out over the area supplied by this nerve.

From—"Symptoms in Diagnosis" by Jonathan Campbell Meakins (Little, Brown and Company).

# IMMEDIATE COVERING OF DENUDED AREA OF SKULL

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**S**URGICAL removal of malignant lesions of the forehead and scalp, especially those lesions which are recurrent, require wide excision. At least 2 cm. of good tissue must be excised beyond the zone of infiltration. Furthermore, for the greatest margin of safety, one must usually go deeply through the aponeurosis and remove the pericranium. The extent of the excision must not be limited by considerations of disfigurement or ease of repair. It is by far wiser to remove too much than too little. While immediate plastic repair is desirable for cosmetic reasons, a more important reason for immediate repair is that experience shows that allowing such wounds to heal by granulation encourages infection with loss of substance and favors recurrence of a malignancy. Many experimental observations on the growth and repair of tissues are available to substantiate this experience as a scientific fact rather than as a mere clinical impression. Certainly, the time honored method of drilling holes through the outer table of the skull to permit granulations to grow up from the cancellous bone has not been satisfactory. We are sure the number of recurrences is greater when the wound is permitted to granulate than when the excision and repair are carried through in one operation. (Fig. 1.)

It is well known that a free skin graft

will not live when placed upon bone surfaces from which the periosteum has been stripped. On the skull, however, we have demonstrated with complete success the feasibility of sliding or rotating large pedicle flaps of scalp or forehead skin graft from one position to another, even though the area of skull which is covered by the flap is entirely denuded of pericranium. (Fig. 2.) This flap is incised down to, but does not include the pericranium. Now when the flap is lifted and shifted into the defect which is to be covered, a fresh area is exposed whose base is covered by pericranium. On this fresh area which has pericranium for a floor, a free skin graft will live. The free split or full thickness graft is obtained from the thigh or abdomen. (Fig. 3.)

## CONCLUSIONS

Whenever the pericranium of the skull is removed surgically or by trauma, the defect should be covered immediately with a full thickness pedicle flap of adjacent scalp. The pedicle flap is raised from but does not include the pericranium.

The defect created by the shifting of the pedicle flap has pericranium for a floor and may be covered by a free graft.

This free graft may be a split or full thickness graft and is usually obtained from the abdomen or thigh.



FIG. 1. Outline of excision showing area of frontal bone to be denuded.



FIG. 2. Parietal scalp has been freed from its pericranium and swung anteriorly to cover defect.

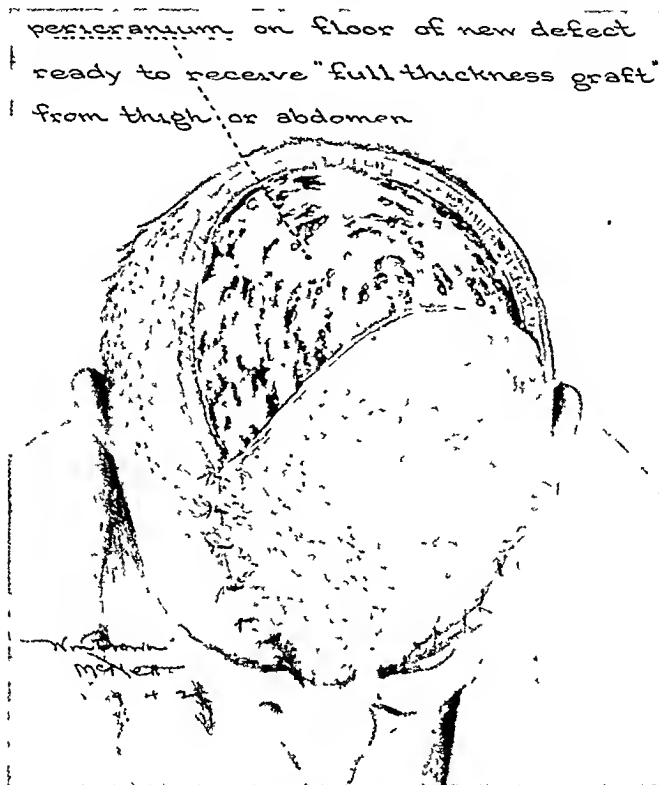


FIG. 3. Parietal defect with floor of pericranium ready to receive full thickness "free" graft from thigh.

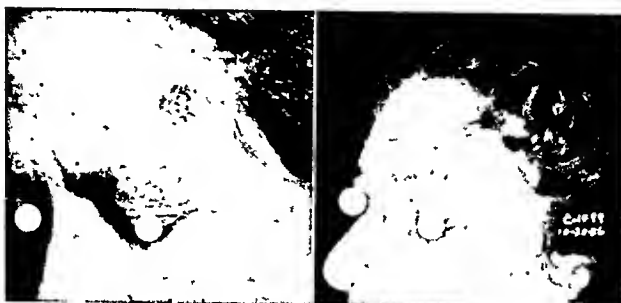


FIG. 4. Case No. 1499. A, sliding graft and full thickness free graft in position; B, hair grown on sliding flap of scalp; C, bald area when full thickness graft is laid.



FIG. 4B.

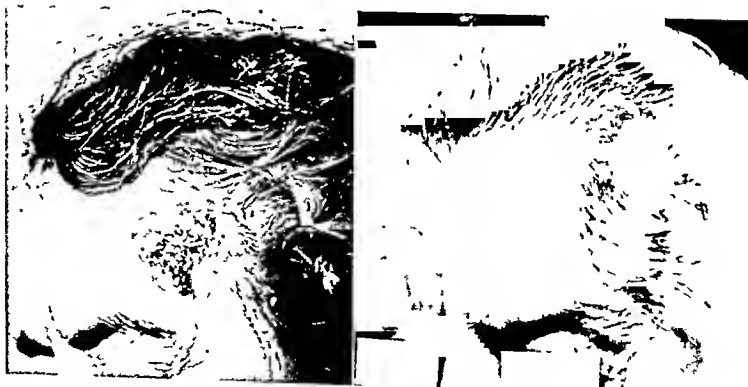
FIG. 4C.



A

B

FIG. 5. Case No. 4169. A, basal cell lesion before excision; B, sliding graft after excision of epithelioma.



A

B

FIG. 6. A, cystic epithelioma before excision; B, hair bearing sliding graft in position after excision of epithelioma.

# A NEW METHOD OF VALVULAR GASTROSTOMY\*

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IN most of the earlier types of gastrostomies, such as the Witzel, the Senn, and the Kader, the fistulous tracts are lined by the serosa of the stomach wall. In spite of the easy technic these gastrostomies have definite disadvantages. Leakage, which soils and irritates the surrounding skin, cannot always be prevented. A permanent tube is necessary in order to prevent the obliteration of the fistulous tract. The serosa is constantly being irritated by the gastric contents and the catheter. If the catheter is removed, it may be very difficult or altogether impossible to reintroduce it. The protruding tube and bulky dressings are an unpleasant ordeal for the patient.

In order to circumvent the disadvantages of a fistulous tract lined by serosa, various attempts have been made to fashion a tube lined with mucosa. In the Beck-Jianu method a long tube is formed from the greater curvature of the stomach. This tube must not only be wide but also long in order to pass through a subcutaneous channel. The utilization of a large part of the stomach for a gastrostomy has its disadvantages, particularly in a contracted stomach. Hour-glass deformity may take place after this type of an operation. In the Janeway method a tube pedicle is formed from a transversely placed rectangular area in the anterior wall of the stomach with its base at the greater curvature. Since this type of gastrostomy does not permit as long a tube as in the Beck-Jianu method, the Janeway type will be less efficient in preventing the escape of the stomach contents. Spivak added a stop-valve at the base of the pedicle tube by the creation of a fold from the stomach wall.

In a recent publication, Richard H.

Sweet reviews his personal experiences with the various methods of gastrostomy. According to this author patients treated by the Beck-Jianu and the Spivak methods are more comfortable and easier to care for than the group in which the serosa lines the fistulous tract. Sweet's observations also indicate that regurgitation is less likely to occur in the Beck-Jianu type than in the Spivak method which technically is easier to form. Those who have had experience with the construction of Pavlov pouches for experimental purposes have observed that in order to prevent leakage from the main stomach there must be no communication between the stomach and the pouch. A small opening in the mucosal diaphragm separating the main stomach from the pouch will permit leakage of the stomach contents. If leakage is prevented in the tubular gastrostomies, such as in the Janeway or Beck-Jianu types, which do not differ from the tube pedicle of the pavlov pouch, it must apparently be due to a kink or to the long tract passing through a subcutaneous channel. The possibility of the abdominal muscles exerting some sphincteric action has been considered important by some.

In most of these tubular gastrostomies one does not find a deep invagination of the tube in order to form a valve. Spivak utilizes a fold near the base of the tube. Herbert D. Adams of the Lahey Clinic suggests that the proximal end of the Janeway gastrostomy "may be inverted a short distance into the gastric lumen, creating a circular valve as in the Senn type of gastrostomy." Quoting further from Herbert D. Adams: "This, however, is not essential for a tight closure of the new canal since it is placed obliquely in relationship

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to the stomach wall and through the rectus muscle so that two different forces tend toward closure and effectually prevent

strangulation of its blood supply and necrosis of the terminal end of the tube. If an invagination of the tubular tract is

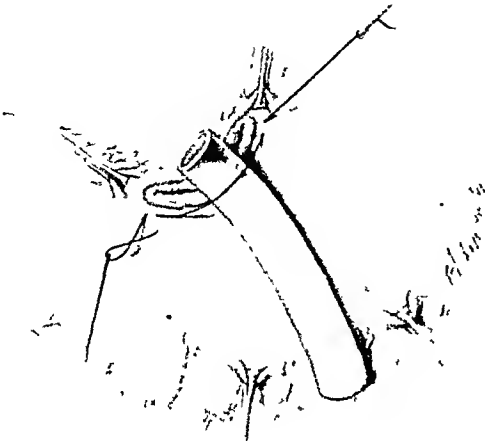


FIG. 1. Incision parallel to the lesser curvature; suturing of the seromuscularis over the rubber tube.

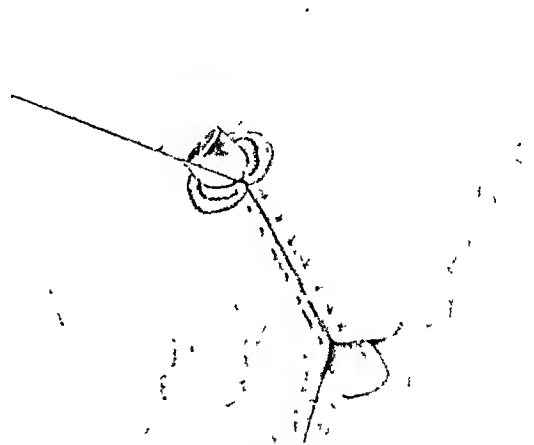


FIG. 2. A tunnel has been formed by the approximation of the anterior stomach wall over the rubber tube.

leakage: first, an increase in the intragastric pressure forces the walls of the tract together, and second, the constricting influence of the rectus muscle." My own

attempted at all, it should encompass the whole length of the tube so that a long channel lined by two layers of stomach wall is formed. The tube thus formed and lined

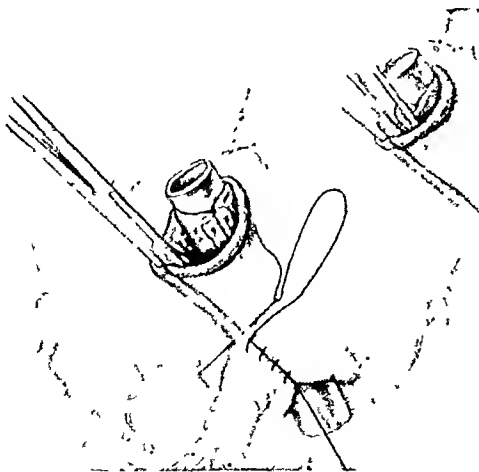


FIG. 3. A crushing clamp in place on the anterior stomach wall. A continuous suture of catgut is begun for closure of the serosal surface of the stomach wall. By the manipulation of the crushing forceps the mucosal surface can be everted and exposed in order to apply an additional suture over the clamp. *Insert:* Two crushing clamps applied anterior to the original suture which fashioned the pedicle tube.

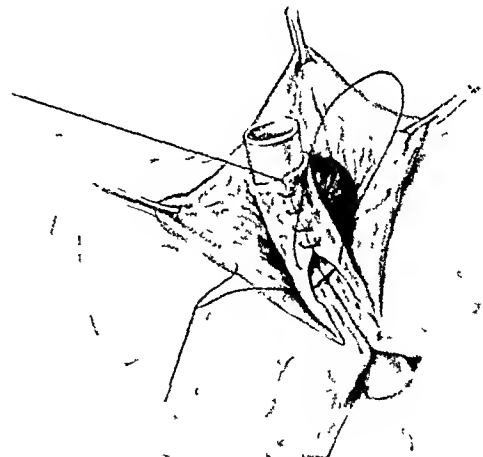


FIG. 4. The mucosal edge of the pedicle tube is sutured over the original seromuscular suture. In this illustration the anterior stomach wall is flared open in order to demonstrate the steps of the technical procedure. The crushing clamps may be dispensed with if every bleeding point is ligated.

experience with this type of a Janeway gastrostomy by inverting the base into the body of the stomach has resulted in the

by mucosa should protrude into the lumen of the main body of the stomach, not unlike that of the ileocecal valve. In order to compensate for the absence of the neuro-

muscular mechanism this valve should be made longer than the ileocecal valve. The invagination should be carried out in such

been carried out on cadavers and dogs before being used on a patient, is performed in the following manner:

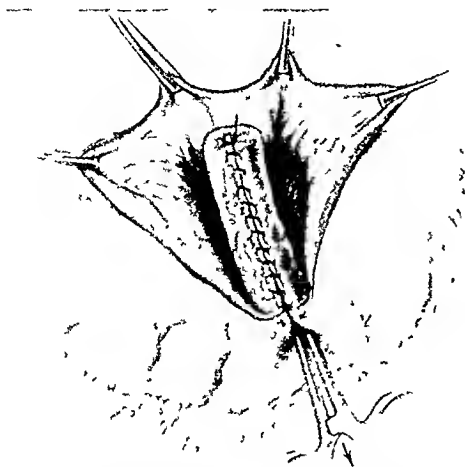


FIG. 5. The pedicle tube has been formed. At this stage it is lined inside by serosa and outside by mucosa. An artery forceps which is introduced through the tunnel pulls on the suture hanging from the terminal end.

a manner that no strangulation of the blood supply is possible. The invagination of the Janeway gastrostomy tube at its base, even for a short distance, as suggested by Adams, necessitates much suturing of the stomach wall around the tube. Such a procedure has not only proved unsuccessful in the patient but also in experimental animals due to strangulation of some of the blood supply. Likewise it failed to create a long tube protruding into the lumen of the stomach and was not lined by two walls snugly hugging each other as was the purpose of the experiments. The next attempt was made to invaginate a pedicle tube at its middle instead of its base. Due to the rigidity of the walls and the narrow diameter of the tube, this maneuver required much force. There was danger of trauma and strangulation of the blood supply. This type of invagination on two experimental dogs resulted in strangulation of the blood supply to the terminal end of the gastrostomy tube. The animals succumbed to peritonitis from necrosis of the terminal end of the tube.

The valvular gastrostomy which is depicted in the illustrations and which has

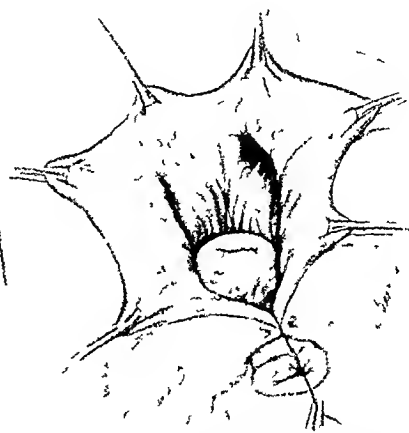


FIG. 6. The pedicle tube has been invaginated. The peritoneal surface of the stomach wall is sutured to the peritoneal surface of the pedicle tube just below its mucosal cuff.

The abdomen is entered through a high left rectus incision. An incision about 5 cm. long and more or less parallel to the lesser curvature is made in the anterior stomach wall. A rubber tube  $1\frac{1}{2}$  cm. in diameter is placed transversely on the anterior wall of the stomach. The seromuscularis of the stomach wall is sutured over the rubber tube. The next step may be carried out either by cutting between two crushing clamps and separating the tube from the main stomach or simply by cutting the stomach wall on each side of the tube and ligating each individual blood vessel. The mucosal edges over the pedicle tube are sutured with catgut. A long artery forceps is introduced into the lumen of the tube from its greater curvature side. At this stage the pedicle tube is lined inside by serosa and outside by mucosa. The terminal end of the tube is invaginated with ease by a gradual pull on the attached suture. In this method of invagination there is absence of crowding and rigidity such as has been experienced in the invagination of Beck-Jianu or Janeway tubes. The defect in the anterior wall of the stomach is closed. The serosa of the stomach wall

proper is sutured to the serosa of the tube just proximal to the mucosal cuff. The valvular gastrostomy, which is double-

through the gastrostomy opening without any leakage taking place after such a maneuver.

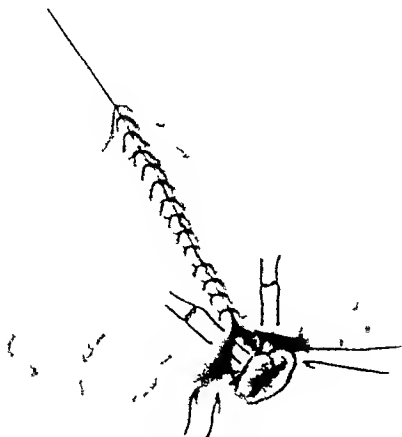


FIG 7. The surgical wound in the anterior stomach wall has been closed. The seromuscularis of the stomach wall is sutured to the pedicle tube at the serosal margin of the cuff.

walled, is thus completely and loosely surrounded by the anterior stomach wall. If leakage should take place in the suture line, it would escape into the stomach cavity and not into the peritoneal cavity. This is also true of the terminal part of the gastrostomy since the stomach wall surrounding the tube is sutured to the peritoneum, the muscle and the skin. Even if partial necrosis of the terminal end should take place, it would not result in peritonitis. On two occasions I have fastened the terminal end only of the tube to the abdominal wall in dogs. This resulted in leakage and peritonitis. When performing this type of gastrostomy in individuals with a thick layer of subcutaneous fat, it is advisable to make two elliptical excisions of the skin on each side of the protruding cuff.

The valvular type of gastrostomy was used on a male patient, seventy-four years old, with carcinoma of the esophagus. It has now been four months since the gastrostomy was performed. At no time has there been any leakage of the stomach contents. This patient uses a large caliber tube during feeding time only. I am also able to introduce my finger into the stomach

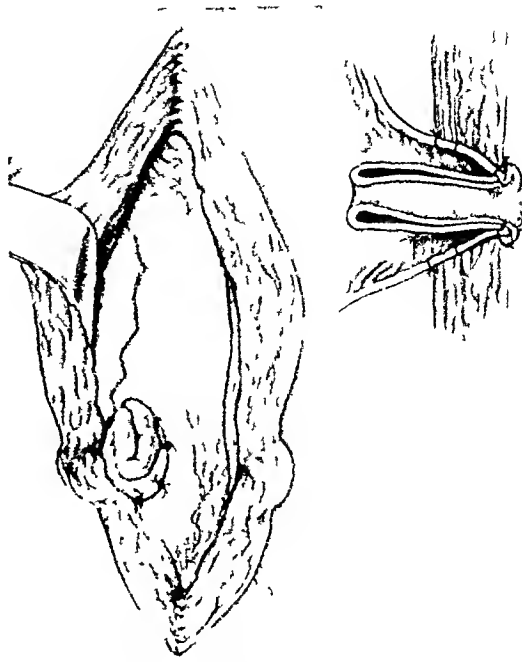


FIG 8 The stomach wall proper is sutured to the peritoneum. *Insert:* Cross section of the valvular gastrostomy. Only the stomach wall proper is sutured to the skin, the muscle and the peritoneum. Leakage from the suture line is unlikely to give much concern since the pedicle tube is inside the stomach.

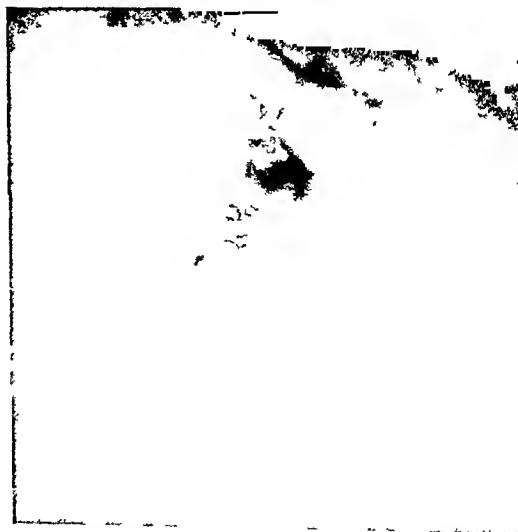


FIG 9 Photograph of the valvular gastrostomy opening four months after the operation.

#### CASE REPORT

CASE No. B-26137. This patient appeared in my office on April 15, 1941, complaining of a

distressing feeling in the epigastrium which he first noticed two months prior. He had the sensation that the food stopped in the stomach. His appetite was poor and there was some loss of weight. Hemoglobin was 88 per cent; white blood count, 13,400; red blood count, 5,005,000. There was no free acidity of gastric contents. The x-ray findings at this time showed no abnormality in the esophagus. The stomach was normal and atonic. Because the x-ray findings were negative, the patient was gastroscopied on two occasions. There was no difficulty in passing the gastroscope through the esophagus at either time of gastroscopic examination. No ulcers or neoplasms could be seen on any of these examinations, only partial atrophic gastritis on the lesser curvature of the stomach.

On June 26, 1941 the patient was explored through an upper midline incision. There were large lymph-nodes on the lesser curvature of the stomach near the cardia. There were smaller nodes in the omentum. A large node from the lesser omentum and one from the greater omentum were removed for frozen section. The pathological diagnosis was that of undifferentiated adenocarcinoma. The nodes from the greater omentum did not show any carcinomatous infiltration. The anterior wall of the stomach was opened and the inside of the stomach explored. There were no tumors seen or palpated. A finger was then introduced into the esophagus through the cardia. At first it admitted my little finger with great difficulty. Later, when the esophagus was dilated, some induration was felt in the lower esophagus. The abdomen was closed after repair of a ventral hernia in the midline. The patient improved and began to take solid and semisolid food. The relief, however, was only for approximately two or three weeks. He began to have increasing difficulty in swallowing so that he could take only small quantities of liquids.

On August 12, 1941 he was explored again with a view to performing a gastrostomy. The

same condition was found as on the previous operation. A typical valvular type of gastrostomy depicted in the illustrations was performed. The patient improved. He was sent for x-ray therapy. At that time another examination was made of the esophagus. An irregularity of the esophagus was found which began at the junction of its middle and lower thirds and cut off the esophagus abruptly at this point. Only a small trickle of barium went down to the stomach. The total length of this stenosis was 12 cm. It was considered inadvisable to give the patient x-ray therapy.

The gastrostomy functions perfectly. There is no need of an indwelling tube. The patient is able to take food through a large diameter tube.

#### SUMMARY

A method for valvular gastrostomy is presented. The tubular gastrostomy projects into the lumen of the stomach and is lined by stomach mucosa on both sides. This type of gastrostomy has been successfully performed on a patient with carcinoma of the esophagus. There was no leakage of gastric contents at any time. A rubber tube was used only during feeding periods.

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# ACROMIOCLAVICULAR DISLOCATION FIXED BY A VITALLIUM SCREW THROUGH THE JOINT

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THERE are several operative methods of reducing the dislocated acromial end of the clavicle. Bunnell, Meyering, and Watkins have each described a technic. Probably the oldest operation is wiring the clavicle to the acromion. This is not always so easy as it appears. By another method, a Kirchner wire is passed through the acromion to engage and hold the clavicle in place. Six weeks later the wire is removed. Recently, Bosworth\* secured excellent results by passing a vitallium screw through the clavicle and the coracoid process. His technic is rather elaborate. The patient is in a sitting position; a special screw is required; the opening in the coracoid is made with an awl passed through that in the clavicle; finally, the bones must be held in position until the screw is driven home.

It occurred to me that a screw might be passed obliquely through the clavicle into the acromion. In a recent case this was done. The clavicle was replaced; a hole was drilled through it into the acromion; a vitallium screw was inserted and driven home, securing the bones in position. Novocain (1 per cent) infiltration was the method of anesthesia. Two months later

the result was entirely satisfactory. The patient is to be drafted into the Army.

Although no conclusions can be drawn



FIG. 1. X-ray taken five days after operation. The oblique view represents the screw as having passed *through* the acromion; but this is not the case. The screw passed into the acromion.

from one case, the simplicity of this method recommends it. Since such dislocations are likely in industry and among our armed forces, the use of a simple method of reducing them seems practical.

\* Bosworth. *Surg., Gynec. & Obst.*, December, 1941.



# Case Reports

## LYMPHOSARCOMA OF THE STOMACH\*

### REPORT OF A CASE WITH SOME CLINICOPATHOLOGICAL NOTATIONS

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AND

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THE earliest reported cases of sarcoma of the stomach found in the literature are those by Sibley,<sup>1</sup> in 1816, and by Bruch,<sup>2</sup> in 1847. Since that time interest has primarily been centered on this type of neoplasm because of its relative infrequent occurrence, and secondly, the more favorable prognosis afforded to a patient with a malignancy arising from lymphoid tissue, in comparison to malignant lesions arising from epithelial tissue of the stomach.

2,067 cases of malignant lesions of the stomach. Haggard<sup>4</sup> found that up to 1920, only 244 cases of sarcoma of the stomach were reported in the literature. In 1931, Askey<sup>5</sup> collected ninety-one additional cases, and in 1941, Cameron and Breslich<sup>6</sup> reviewed the literature and found 104 isolated cases of gastric sarcoma had been reported in the preceding ten years (1930 to 1940). In all, less than 500 cases have been reported up to the present time. (Table 1.)

TABLE 1  
INCIDENCE OF SARCOMA IN MALIGNANT LESIONS OF  
THE STOMACH

Author	Year	No. Cases Carcinoma	No. Cases Sarcoma
Smithies and Ochsner <sup>7</sup> . . .	1919	921	4
Pack and McNeer <sup>8</sup> . . . . .	1935	400	5
Cheever <sup>9</sup> . . . . .	1913-1932	628	9
Walters et al. <sup>10</sup> . . . . .	1907-1938	6,242	110
Cameron and Breslich <sup>6</sup> . . .	1930-1940	135	2
Cook County Hospital <sup>11</sup>			
11,882 autopsies . . . . .	1930-1940	272	6
Surgical Pathology . . . . .	1933-1940	180	3
Total . . . . .		8,778	139

Masson<sup>3</sup> reviewed the cases of malignant lesions of the stomach encountered at the Mayo Clinic from 1908 to 1920 and found only thirteen proved cases of sarcoma in

### CASE REPORT

A. D., a white male, aged sixty-three, was admitted April 22, 1941, to the Cook County Hospital (surgical service of Dr. J. B. O'Donoghue) with complaints of anorexia and vomiting following the ingestion of food of two months' duration. Marked generalized weakness of six weeks' duration was present. It was learned, however, that his immediate reason for seeking hospitalization was because of persistent abdominal pain of four days' duration which was described as cutting like, and located to the right of the umbilicus. Radiation of the pain across the epigastrium to the left hypochondrium would occur upon the ingestion of food. At the onset of his illness, the patient was able to retain milk and soup, but for three weeks preceding hospitalization, emesis would occur whenever any food with the exception of milk was taken.

A weight loss of 50 pounds had occurred during the past year; hematemesis or tarry

\* From the Departments of Surgery, Cook County Hospital and Loyola University School of Medicine. Read before the Chicago Pathological Society, January 12, 1942.

stools had never been noted by the patient. His past medical history was irrelevant. His familial history was of having a brother suc-

one examination of the stool was made, this was negative for blood. The blood cevitic acid level was 0.1 mg.

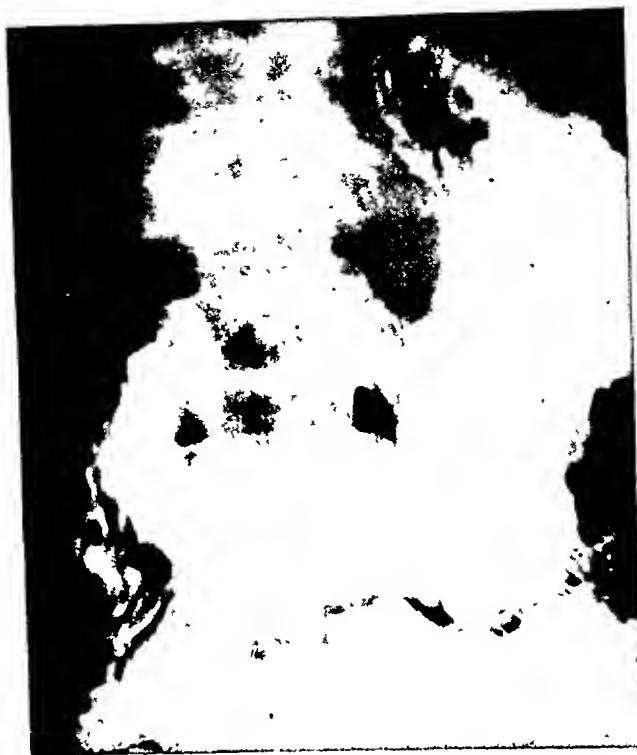


FIG. 1. Roentgenogram showing large filling defect involving the pars prepylorica and the distal half of the pars media of the stomach.

cumb to a stomach ailment; however, the exact nature was not known to the patient.

On physical examination, the patient appeared emaciated and exhibited a marked generalized weakness. His temperature was 97.6°F.; pulse rate 84; respirations 20 and blood pressure of 124/100. The essential physico-pathological findings were limited to the abdomen which was scaphoid; tenderness on palpation was present in the epigastrium. No masses were palpable, although the liver edge was just made out below the right costal margin.

Laboratory examination revealed the blood hemoglobin to be 75 per cent (Sahli), the erythrocytes numbered 4,200,000 and the leukocytes 10,000 cells per cubic millimeter, respectively. The serological reaction was negative, as was also the urine for albumin, sugar, bile and blood. Gastric analysis by the Ewald test meal revealed an absence of free hydrochloric acid; the combined acid, however, was 53 degrees. Blood was absent both grossly and chemically from the stomach contents. Only

A barium meal was administered and the roentgenologist found a large, rigid, superimposable defect involving the entire pars prepylorica and the distal half of the pars media. The opinion was expressed that the findings were indicative of an advanced carcinoma of the stomach. (Fig. 1.) Gastroscopic examination confirmed the roentgenological findings. A roentgenogram of the chest revealed no apparent metastasis. The patient was prepared for operation, the preoperative diagnosis being carcinoma of the stomach, although the absence of blood in the stool could not be correlated with the clinical history and laboratory findings.

On May 6, 1941, under cyclopropane anesthesia the abdomen was opened through a left para median epigastric incision. A large firm mass involving the pyloric and prepyloric portions of the stomach was present. The perigastric lymph-nodes were enlarged and firm. No apparent metastasis in the liver or to the peri-aortic lymph-nodes were present. The lesion appeared resectable; accordingly, the

stomach was mobilized and a high subtotal gastric resection was performed. The continuity of the gastrointestinal tract was re-established by the Pólya type of gastrojejunostomy.

The resected specimen was submitted to the

referred to the x-ray therapy division where he received twenty-one treatments from May 26 to August 12, 1941, each treatment consisting of 300 r units, the rays being administered over five fields.

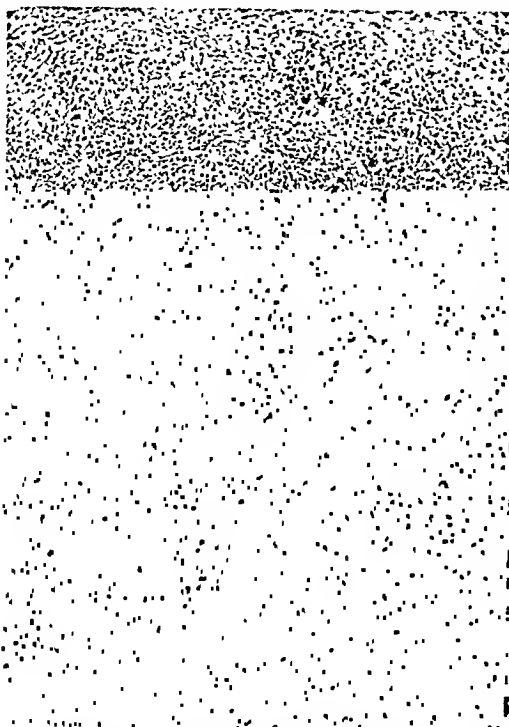


FIG. 2. Low power photomicrograph taken from ulcerated area of the stomach showing diffuse lymphocytic infiltration of the stomach wall. (Hematoxylin-eosin stain.  $\times 99$ .)

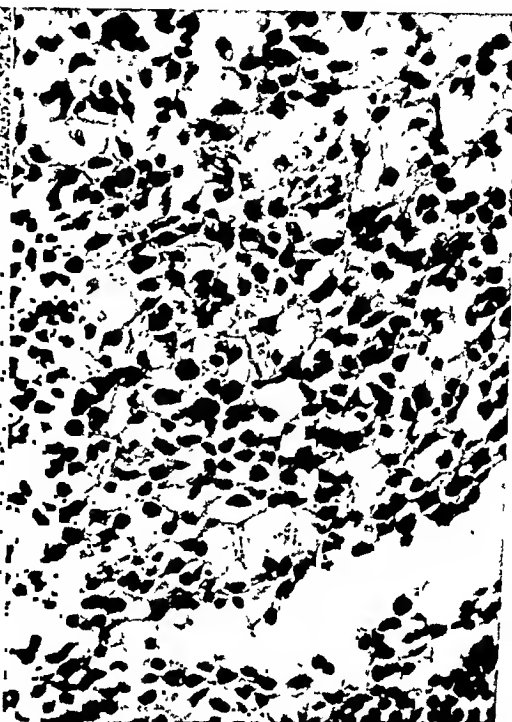


FIG. 3. High power photomicrograph showing infiltration of stomach wall by lymphocytes. The nuclei are rich in chromatin and are surrounded by a narrow rim of a pale staining cytoplasm. Variations in size and shape are present. (Hematoxylin-eosin stain.  $\times 670$ .)

Department of Surgical Pathology and was described as follows: Grossly: "In the mucosa of the distal end is a  $5.5 \times 6.5$  cm. ulcer located on the lesser curvature. The edges of this defect are firm and rolled, the base is clean. Just proximal to the ulcer is a slight narrowing of the lumen and another ulcer, measuring 2.5 cm. in diameter is present whose edges are more irregular. Several lymph nodes, the largest measuring up to 1.2 cm. in diameter are attached to the pyloric end. Microscopically, sections taken from the ulcerated area reveals a reticulum cell sarcoma of the stomach."

The postoperative course was entirely uneventful, multiple blood transfusions, parenteral fluids, intravenous cevitic acid together with general supportive measures resulted in his being afebrile on the fourth postoperative day. On his fourteenth postoperative day, the patient was discharged from the hospital and

The patient has since gained 30 pounds in weight, feels stronger and at the present time is working. A barium meal given on December 5, 1941, shows a well functioning stoma and no apparent neoplastic involvement of the stomach. (Figs. 2 to 6.)\*

#### DISCUSSION

The frequency of the sarcoma of the stomach was given in 1919 by Ewing<sup>12</sup> as comprising 1 per cent of all gastric malignancies. This is in conformation with operative and autopsic statistics from German clinics given by Ziesche and Davidson<sup>13</sup> a decade earlier.

\* On September 14, 1942, this patient was contacted. He is going to business and is feeling fine.

In the ten-year period from January 1, 1930 to January 1, 1940, a total of 11,882 consecutive necropsies were performed at

were seen, compared to 180 cases of carcinoma of the stomach, giving a ratio of 1 case of sarcoma to every 60 cases of



FIG. 4.

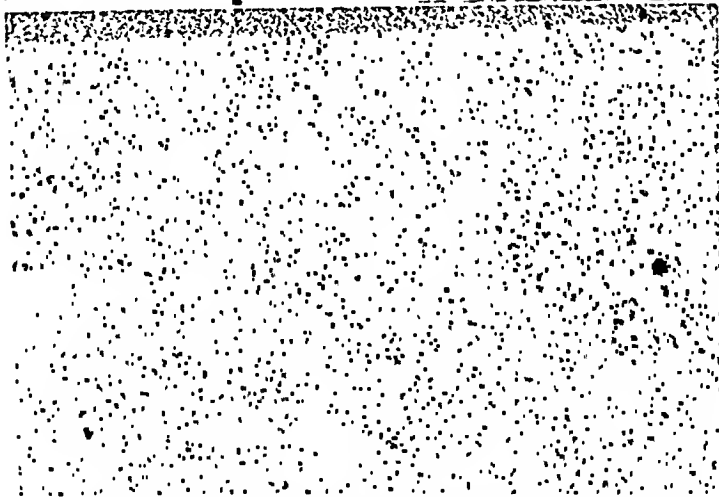


FIG. 5.

FIG. 4. High power photomicrograph showing separation of the muscle bundles of the stomach by invasion of the lymphosarcomatous cells. (Hematoxylin-eosin stain.  $\times 670$ .)

FIG. 5. Low power photomicrograph of a perigastric lymph-node. Only one lymph follicle is present. The remainder of the architecture has been replaced by lymphosarcomatous elements. (Hematoxylin-eosin stain.  $\times 99$ .)

the Institute of Pathology of the Cook County Hospital. In this total, 278 cases of malignant lesions of the stomach were encountered, of these six cases were sarcoma. Only two of the latter were of the lymphosarcoma type.

Similarly, the statistics of the Department of Surgical Pathology for the seven and a half period from July 1, 1933, to January 1, 1940, reveal that only three cases of lymphosarcoma of the stomach

carcinoma. This ratio is in conformation with the most recent statistics of the Mayo Clinic<sup>10</sup> comprising 6,352 operative cases of malignant lesions of the stomach observed in the thirty-one years elapsing from 1907 to 1938, of which 110 cases were sarcoma, the ratio being 1:58.

Considerable disagreement in the terminology and classification of neoplastic and neoplastic-like lesions of the lymphoid system exists because of the lack of knowl-

edge as regards the etiology and histogenesis of these lesions.

Trauma was emphasized by early au-

type of lesion may be difficult is evidenced by a case cited by Kirshbaum<sup>14</sup> and also by Eusterman and Balfour<sup>15</sup> which was



FIG. 6. Roentgenogram taken seven months after operation showing stoma of stomach with no apparent neoplastic involvement.

thors as the causative factor; the theory of degeneration of benign lesions of the stomach into malignant ones, as polyps to carcinoma, or myoma to sarcoma have been advanced. Other theories, as tuberculous lesions of the stomach causing irritation in the presence of aberrant undifferentiated cells in the submucosa, or the chronic irritation produced by peptic ulcer are speculations that have been offered.

Ewing is of the opinion that lymphosarcoma may begin as an inflammatory process. In discussing the origin of this tumor in the stomach, Ewing states the following questions must be answered: Is it part of a leukemic process? Is it part of a gastrointestinal pseudoleukemia? Is it part of a generalized lymphosarcoma, or is it solely a localized tumor?

That the pathological diagnosis of this

reported by Freeman,<sup>16</sup> wherein sections taken from a case of gastric sarcoma were submitted to several noted pathologists, who presented various diagnosis of carcinoma, lymphosarcoma, inflammatory tissue and chronic granuloma.

Ewing classifies sarcoma of the gastrointestinal tract as (1) spindle cell myosarcoma, (2) miscellaneous round cell or mixed cell alveolar sarcoma and (3) lymphosarcoma.

Primary lymphosarcoma of the stomach may arise from any lymphatic tissue in the organ. It is probable, however, that the lesion begins most often in a lymph follicle in the submucosa. From this point of origin, it penetrates along the tissue spaces and infiltrates the various layers, particularly, the muscle layers, each band of muscle being separated by large masses of tumor

cells. The submucosa is enormously thickened and this explains the giant rugae that are sometimes seen in a roentgenogram. The mucosa, not being the site of the original growth does not show the early characteristic ulceration of carcinoma. However, later, ulceration does take place and characteristic ulcer niches and craters may develop. These tend to be more shallow than in carcinoma and frequently are multiple. Involvement of the serosa is usually a late manifestation but often assumes great proportions. Due, perhaps to compromise of the blood supply by diffuse infiltration of all the layers, necrosis is frequent and for this reason perforation is not uncommon.

Koucky<sup>17</sup> and his associates in reporting an unusual case of an acute perforation of a lymphosarcomatous ulcer of the stomach occurring in a male, aged fourteen, with the clinical picture of a perforated peptic ulcer are of the opinion that the largest number of perforations occur into adjacent structures with or without a sarcomatous peritonitis. They advocate the opinion expressed by McNealy<sup>18</sup> of the advisability of taking a biopsy from every case of gastric perforation.

From a study of sixty-seven cases of sarcoma of the stomach, Madding and Walters<sup>19</sup> found the lymphosarcoma as being the most common form. These are divided into two types: (1) reticulum cell sarcoma, (or the large round cell lymphosarcoma and (2) malignant lymphocytoma (or the small round cell lymphosarcoma). This differentiation is further emphasized by Madding and Walters as being of a practical and clinical significance, inasmuch as the two types differ in their response to roentgen therapy. Krumbhaar<sup>20</sup> is of the opinion that the reticulum cell sarcoma is more resistant to roentgen therapy than is the malignant lymphocytoma.

The location of the lesion is most usually in the antrum, but generally is far enough away from the pylorus so that obstruction by the tumor is uncommon. Our case

differed from this, in that the lesion produced symptoms of pyloric obstruction.

#### CLINICAL FEATURES

Sarcoma of the stomach occurs at a much earlier period of life than does carcinoma. From statistics of large numbers of cases in the literature, the average age of carcinoma of the stomach is given as sixty-one years, although in our series of 272 cases of carcinoma of the stomach, the average age is found to be fifty-five years; whereas the average age of sarcoma of the stomach is found to be forty-one years. Case reports of sarcoma of the stomach occurring in the extremes of life are present in the literature, Finlayson,<sup>21</sup> reporting the youngest patient as three and one-half years of age, Hunt,<sup>22</sup> reporting a case in a patient three years and eight months of age, and Gosset<sup>23</sup> reporting the oldest patient as being eighty-five years of age.

Balfour and McCann<sup>24</sup> in reviewing a series of fifty-four cases of sarcoma of the stomach found their youngest patient to be ten years of age and the oldest sixty-seven years of age, the average for the group being forty-three years.

As to sex, the frequency was predominately in the male sex, the incidence ranging from 60 to 70 per cent, which conforms to the male preponderance existing in malignant lesions of the stomach.

Pain is the most common feature and is either generalized throughout the abdomen, or, more often localized to the mid-epigastrium. In many cases, the pain is similar to that seen in peptic ulcer. Other symptoms are belching, anorexia, epigastric nocturnal pain and loss of weight and strength. The relationship of symptoms to lesion is emphasized by Madding and Walters inasmuch as the reticulum cell sarcoma arises from the reticulum cells of the lymph follicles in the submucosa; and since the sarcoma originates in the submucosa, the mucosa itself is not early involved and ulceration does not occur as soon as it does in carcinoma because of the proximity of the sarcoma to the submucous

plexus of nerves, pain is a very common feature.

The average duration of symptoms is found to be from two months to several years. In the inoperable cases the average duration of symptoms is about thirty-seven months.

Gastric analysis reveals an achlorhydria in the largest number of cases, although normal acid values were found in 20 per cent of the cases reported by Madding and Walters. The blood picture is usually that of a microcytic hypochromic type. Blood in the stool is generally absent, and is present only in the late cases when the mucosa has become ulcerated.

Roentgen examination by barium meal is usually resultant in a diagnosis being made of carcinoma. Holmes, Dresser and Camp<sup>25</sup> are of the opinion that nothing diagnostic is present roentgenologically in lymphosarcoma of the stomach, but that in some cases, peristaltic movements are not as much interfered with as in cases of carcinoma.

Giere<sup>26</sup> recently reported a case diagnosed correctly by gastroscopic examination, one month after roentgen examination had failed to disclose the presence of any abnormality of the stomach.

The prognosis is somewhat better in cases of sarcoma of the stomach than in carcinoma. The average life span in the Madding and Walters series was a little over three years, the longest survival period for any patient being fifteen years. Jones and Carmody<sup>27</sup> report the case of a patient who at the age of nine years underwent a subtotal gastric resection for lymphosarcoma of the stomach who is alive and well nineteen years later.

The treatment of sarcoma of the stomach might at first glance seem a hopeless subject, but such is not the case. In fact, quite the opposite is true. At the onset, we can say that in cases of tumors of the stomach of comparable size, one a carcinoma, the other a lymphosarcoma, that the latter will in the hands of surgery, together with

postoperative x-ray therapy have a better prognosis and a greater longevity.

We believe that all tumors of the stomach should have the opportunity of laparotomy inasmuch as the ratio of operability of lymphosarcoma has been reported by various authors as being from 60 to 85 per cent. The reason for this being, that lymphosarcoma metastasizes late and then usually to the regional lymph-nodes in the gastrohepatic and gastrocolic omentum, also because the tumor mass usually remains within the stomach wall and does not become attached to adjacent viscera. This is not true for spindle cell sarcoma, leiomyosarcoma or fibrosarcoma, and lastly most of the cases of lymphosarcoma occur on the lesser curvature in the lower segment of the stomach, where, when the stomach is mobilized, the tumor may be resected and the continuity of the gastrointestinal tract be re-established.

In our review of the literature it was found that more than 60 per cent of all the sarcomas of the stomach are lymphosarcomas, and of these 50 per cent are malignant lymphocytomas, and 50 per cent are reticulum cell lymphosarcomas.

An important statement recently made by Desjardins<sup>28</sup> was "That if lymphosarcoma could be diagnosed early, most of them could be cured by radiation therapy alone." On this statement hinges the crux of the treatment of all tumors of the stomach, that is, early diagnosis. This is one of the perplexing problems of the medical profession, inasmuch as early diagnosis is difficult to accomplish because of the many factors which are hard or impossible to control.

The first of these is the patient, who through medical education must be directed to the doctor for any digestive disturbance early in its course, hence eliminating the delay of the period of self medication. The second factor, is the doctor, and the one mostly at fault. This fact we are impressed with in reviewing the literature and noting in the case reports, the long interval that elapses between the

time the patient first seeks medical attention and the date of instituting adequate medical help, namely, surgical intervention.

Earlier diagnosis can be made only by a thorough and painstaking history, a complete physical examination, (which is usually negative), followed by gastroscopic study and a radiological check-up. We believe that the greatest aid in making a diagnosis earlier will come through advancement of gastroscopic study, inasmuch as the involvement of the stomach wall by a lymphosarcoma throws up rugae which are markedly exaggerated and have been described as lobulated without involvement of the mucosa. This finding, together with an x-ray deformity in an individual with a gastric complaint may lead to the diagnosis of a neoplasm of the stomach. In the presence of these findings, a laparotomy is indicated and justified, since surgery supplemented by roentgen therapy can and does offer these patients a cure.

In conclusion, we wish to point out that lymphosarcoma is not a rare condition, that it occurs in from 1 to 2 per cent of all gastric malignancies, that it occurs at an earlier period of life than does carcinoma, that it metastasizes late and that it responds more favorably to surgery than does carcinoma, even when the lesion appears hopeless from a roentgenological and gastroscopic viewpoint.

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# MULTIPLE ADENOMATOSIS OF THE COLON

## CASE REPORTS

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IN 1934, Lockhart-Mummery pointed out that "Multiple Adenomata of the Colon" is a definite disease entity, occurring as a familial disease quite independent of multiple polyposis resulting from ulceration and infection. He places this condition in the same category as hemophilia, albinism, brachydactyli and similar hereditary conditions. It is now pretty well accepted to be a Mendelian dominant appearing in and being transmitted by both sexes. The condition apparently does not appear until about puberty, so it is concluded that the hereditary factor is the susceptibility of the epithelium of the large intestine to proliferate at a certain age.

These adenomas may be sessile or polypoid, varying greatly in size and number, and found distributed from the cecum to the rectum. The patient may be symptomless and entirely unaware of the condition, or there may be present the symptoms of ulcerative colitis with diarrhea accompanied by blood and mucus in the stool. There may be periods or attacks of intermittent cramps, and even intestinal obstruction can be the first sign of trouble. The first premonitory sign in one case was a profuse rectal hemorrhage.

A review of the literature reveals the fact that a large percentage of these cases develop malignancy, and Jones is probably justified in his statement that if these patients live long enough they will all die of carcinoma. Accepting this as a fact leaves but one choice in the treatment, and that is total colectomy. The malignancy may develop in any one or several of the adenomas, cases having been reported with multiple primary carcinoma in different segments of the large bowel. I am con-

vinced that if there are numerous adenomas in the rectum, it should also be removed; for it is quite conceivable that a small carcinoma or early degeneration of a polyp could be present and not recognized. Few there are who would recommend fulgeration for carcinoma of the rectum, so it would seem to be that ileosigmoidostomy with fulgeration of the rectal polyps be reserved for those patients who absolutely refuse the more radical operation.

In this day and age of highly developed x-ray technic with contrast media, along with sigmoidoscopic examination the diagnosis is usually readily made.

## CASE REPORTS

CASE 1. S. A., a white female, age twenty-five, came in on May 8, 1940 because of rectal bleeding. Her present history was that she had been enjoying excellent health prior to six days before admission. While at church on May 3 she became suddenly weak and fainted, following which she passed a quantity of bright red blood per rectum. However, aside from weakness she had no symptoms of pain, nausea or vomiting. On May 4 several clots were passed and the following day the patient had tarry stools. On May 6 she again had a weak spell and passed more bright red blood. The day before admission she again had an attack of faintness accompanied by pain and pressure in lower portion of the abdomen, and this was also followed by the passage of blood. On the morning of admission she had walked about a block from the house when she had to sit down because of weakness, buzzing in the head and air hunger. She then went to her family physician who immediately referred her in to the hospital.

Her history was essentially negative except for an attack of indigestion with lower abdominal pain accompanied by diarrhea two years ago. There was no rectal bleeding at that time and the diarrhea cleared up completely

in about two weeks. Physical examination revealed a well developed and nourished white female with marked pallor of skin and mucous

whole blood on May 9, and treatment immediately instituted against the *entamoeba histolytica*.



FIG. 1. Specimen removed at first operation. Instrument indicates sessile polyp which microscopically showed early malignant degeneration.

membranes. Moderate dehydration also was present and the patient felt weak. Pulse rate was 96, regular and with fair volume; blood pressure was 110/70.

Palpation of the abdomen revealed moderate tenderness throughout the lower portion. There was no spasm, and no masses were palpable. Digital examination of the rectum revealed the presence of several small polypoid masses. A sigmoidoscope was then passed for a distance of 20 cm. and this revealed the presence of innumerable polyps varying in size from 1 mm. to 1.5 cm., distributed from the orifice on up to the limit of examination. No bleeding point was seen and no ulceration was present.

Laboratory findings revealed a red blood count of 2,900,000 with 40 per cent hemoglobin; white blood count of 7,900 with 66 polymorphonuclears. Stool examination besides showing macroscopic blood, revealed presence of few cysts of *entamoeba histolytica* and many blastocysts.

The patient was given a transfusion of 500 cc.



FIG. 2. Photograph of preserved specimen. A, terminal ileum, cecum, ascending and transverse colon; B, descending colon and rectum.

X-ray examination with barium enema revealed polypoid masses to be distributed throughout the large bowel, but no evidence of ulceration or other inflammatory process.

The patient was discharged on May 31, 1940, having shown marked improvement, with a red blood count of 4,600,000, hemoglobin 70 per cent, but still having *entamoeba histolytica* and blastocysts present in the stool. Treatment was continued at home and stool examination one month later revealed no amoeba present. However, she continued to have an occasional show of bright red blood in the stool.

She was readmitted to the hospital for further study on December 4, 1940 because she had developed rather severe bearing down pain in the abdomen. Sigmoidoscopic examination at

this time revealed what seemed to be an increase in number and size of the polyps. X-ray examination with barium enema showed us that there was possibly developing an obstructing lesion in the sigmoid, due either to increase in size and number of polyps, or malignancy.

The radical operation of total colectomy was advised and refused. The patient was discharged from the hospital on December 6, but returned December 30 with her mind made up to undergo this extensive procedure.

It was decided to attack this problem by doing a perineo-abdominal resection of the rectum and as much of the left side of the colon as possible as a first stage, the thought being that by so doing the patient would have a chance to accommodate and establish in degrees her fluid balance. This first stage was accomplished on January 4, 1941, leaving a colostomy just below the level of the splenic flexure.

The postoperative course was essentially uneventful, the patient being able to sit up on the fourteenth postoperative day. The abdominal wound was healed and fluid balance was maintained in spite of profuse liquid stools for two to three days after removal of the colostomy clamp.

On January 27, after the patient had been up and around for a week, the second stage or permanent ileostomy was performed through a McBurney incision. Following this stage the patient had a rather severe mental upset, but nevertheless was up in a chair on the ninth postoperative day. The profuse liquid drainage from the ileostomy was soon brought under control by means of low residue diet supplemented with generous amounts of kaomagma.

The patient had been up and around, feeling and looking well for about three weeks when the third and last stage was undertaken on February 24. At this operation the entire remaining colon was removed. She was finally discharged from the hospital on March 24, with ileostomy under control and the patient able to take care of herself satisfactorily. She has been going about her regular duties, is on a very liberal diet, and does not complain about wearing an ileostomy bag which she has to change but once or twice daily.

Pathological examination of the specimen removed showed it to be a true adenomatosis of the colon. There was one small area 2 cm. in diameter at the lower end of the descending colon in which was demonstrated early malig-

nant degeneration. There was no ulceration in any portion of the large bowel. The presence of amoeba on the stool examination apparently was an incidental finding, the infestation having possibly occurred two years before when she had an attack of diarrhea without further sequelae.

**CASE II.** F. C., a white male, age forty-two, presented himself on January 11, 1941 because of profuse rectal bleeding the day before. He stated that he had had a similar occurrence in 1935 at which time he had seen a physician who removed a piece of tumor from the rectum and told him that there was no cancer present. His history was otherwise essentially negative.

Examination revealed a well developed and nourished white male, not acutely ill. There were no abnormal findings except for the rectum. On digital examination there were palpable numerous polypoid masses with a cauliflower lesion just palpable. Sigmoidoscopic examination revealed numerous polyps and a moderately sized lesion posteriorly which had all the appearances of carcinoma. X-ray examination with barium enema revealed polypoid masses distributed throughout the large bowel.

Biopsy and exploration with possibility of radical resection was advised and refused. Biopsy was finally consented to in April, 1941, and a diagnosis of adenocarcinoma established, but he still refused any further procedure. In May, 1941, a colostomy was performed, because of intestinal obstruction, at which time extensive metastases were found. The patient survived six weeks. Possibly this outcome could have been avoided had radical treatment been carried out in 1935.

**CASE III.** This patient, a white female, age fifty-two, presented herself because of a diarrhea of one week's duration. Digital examination revealed no palpable masses in the rectum, but sigmoidoscopic examination revealed a cauliflower growth 20 cm. from the anal orifice, clinically appearing carcinoma. X-ray examination with barium enema demonstrated numerous large polyps throughout the large bowel. This patient had never had occasion to consult a physician previous to this time. Radical operation was advised and refused and the case went to other hands.

This case is merely mentioned to add to the statistical evidence on malignant de-

generation of multiple adenomatoses of the colon.

#### SUMMARY AND CONCLUSIONS

Three cases of multiple adenomatosis of the colon, all of which had developed malignancy, are presented.

The case in which total colectomy was done has a family history indicative of familial disease, her mother having died at an early age from malignancy of the bowel. She also demonstrates the advantage of early resection of the left colon leaving as high a colostomy as possible, in that we encountered very little difficulty in establishing and maintaining fluid balance, and we found one area of early malignant degeneration with no evidence of metastases.

The permanent ileostomy, which is usually feared because of its continuous profuse liquid drainage with resulting skin irritation, has been no particular problem in this instance. As stated before, this was brought under control by low residue diet with generous amounts of kaomagma, the dietary régime used being that suggested by Cattell in his paper on the care of the colostomy. The patient now has two to three formed stools daily (on a liberal diet

without kaomagma) and when stools become liquid she reverts to the first diet for a day or two.

Total colectomy, though a formidable procedure, should be advised for all cases of adenomatosis. A permanent ileostomy need not be much more of a care than a colostomy if the patient is given the opportunity of getting the ileum accommodated by first doing a high colostomy rather than an ileostomy as the first stage, and also if due care is taken with the dietary régime.

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# CONGENITAL HYPERTROPHY OF THE LOWER EXTREMITY ASSOCIATED WITH ELEPHANTIASIS\*

## CASE REPORT

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**E**LEPHANTIASIS is a condition of chronic swelling of an extremity due to congenital or acquired deficiency of the lymphatic drainage and characterized by lymph stasis in the skin and subcutaneous tissues associated with diffuse fibrosis of the subcutaneous tissues. Several varieties of elephantiasis are recognized: Tropical or filarial elephantiasis, a group of idiopathic congenital or familial cases including elephantiasis nostra and Milroy's and Meige's disease, surgical elephantiasis, and an ill defined group due to lymphangitis, lymphadenitis, deep thrombophlebitis associated with lymphangitis, and lymphatic block due to tumor infiltration. Elephantiasis is ordinarily not associated with hypertrophy or overgrowth of the affected limb. Congenital hypertrophy of a limb may occur without apparent cause or, more commonly, in association with some vascular abnormality, notably hemangioma or some abnormal arteriovenous communication. Numerous instances of the various types of elephantiasis and of the different varieties of congenital hypertrophy associated with vascular abnormalities have been recorded in the literature. The combination of congenital hypertrophy due to vascular abnormality associated with a true elephantiasis is a rare occurrence and I know of no reported case. For this reason a case of congenital malformation of the subcutaneous tissues associated with diffuse hemangioma, lymphatic obstruction, hypertrophy of the limb, and elephantiasis is presented. Furthermore, the case illustrates the wide and successful applicability of the Homans' operation for the relief of

elephantiasis and permits some observations on the cause of elephantiasic fever.

## CASE REPORT

The following is a case of congenital anomaly of the right lower limb associated with diffuse hemangioma of the subcutaneous tissue and skin, subcutaneous fibrosis, deficient lymphatic drainage, elephantiasis and hypertrophy of the extremity.

No. 189243, R. A., a white male coal-miner and mill worker, was admitted to the hospital on January 4, 1940, complaining of swelling of the right lower extremity. There was no family history of elephantiasis or of hemangioma. His past history was essentially negative. Except for the chief complaint, he had always enjoyed good health, and the review of systems was not remarkable. He stated that at birth the right lower limb was larger and longer than the left. The discrepancy grew gradually and steadily more noticeable with the passage of years. As a child he had no disability, but in recent years he had had considerable difficulty in using the right leg. Six years previously he had begun to have small blebs on the skin of the leg which would rupture, drain large quantities of clear fluid and often leave a sort of warty lesion. The leg enlarged progressively. At the age of sixteen he first began to have attacks of elephantiasic fever, with rapidly spreading soreness and redness of the entire leg and thigh, severe prostration, high fever and often chills. Sometimes the temperature went to 105°F. or higher. He had had about twenty severe attacks and many more milder ones lasting only a few days. Sometimes there was soreness in the region of the inguinal nodes during attacks. He stated that his right leg sweated much more profusely than the left and that it was always

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warmer than the left. During the past year he had had six severe attacks which necessitated bed rest from several days to several weeks.

only a muffled systolic sound over the left, a condition which was considered to indicate greater blood flow but was not conclusive of

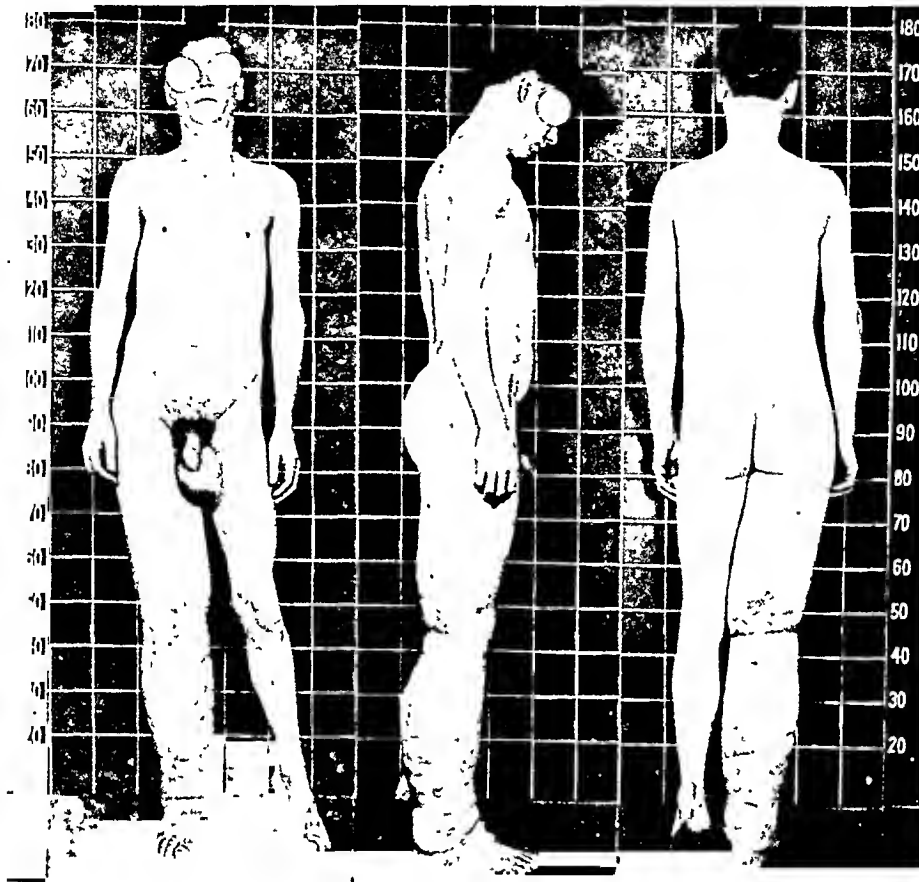


FIG. 1. Photographs taken on admission to the hospital.

Examination showed a fairly well nourished and well developed man of thirty-three. Blood pressure, temperature, pulse and respirations were normal. Blood count, urine, and Wassermann test were negative. The general examination was not remarkable. The entire right lower extremity was enormous. (Fig. 1.) It was warmer than the left and presented a faintly cyanotic reddish color which extended up as high as the buttocks. In the popliteal space and over the anteromesial surface of the ankle the skin was purplish, wet, and excoriated and there were a number of warty excrescences and peculiar blebs which were easily ruptured and wept a clear fluid. The entire limb sweated profusely. The swelling was maximal at the ankle and extended up to the pelvis, and on palpation was very hard and pitted very little with pressure. The extremity was 8 cm. longer than the contralateral limb. There was a definite bruit over the right femoral artery and

arteriovenous fistula. Occlusion of the right femoral artery by digital pressure or by a cuff about the thigh caused no change in pulse rate or blood pressure. With both legs exposed in a room at 20°C., both feet cooled, but the toes on the right foot remained about 1.5° warmer than those on the left, the right leg about 4.5° warmer than the left. With body heating, the skin temperature of the toes on the right began to rise a few minutes before a rise began in the toes on the left, and when maximal dilatation occurred the toes on the right side were about 1.5° warmer than those on the left. It was believed that these studies were indicative of an increased blood supply, though not of an abnormal arteriovenous communication. Soft tissue roentgenograms showed the typical trabeculation of the subcutaneous tissue which Reichert<sup>1</sup> demonstrated was characteristic of elephantiasis and of the elephantoid state. (Fig. 2.) The long bones were longer and larger

than normal but otherwise showed no change. With elevation of the limb there was a gradual diminution in size of the extremity and an

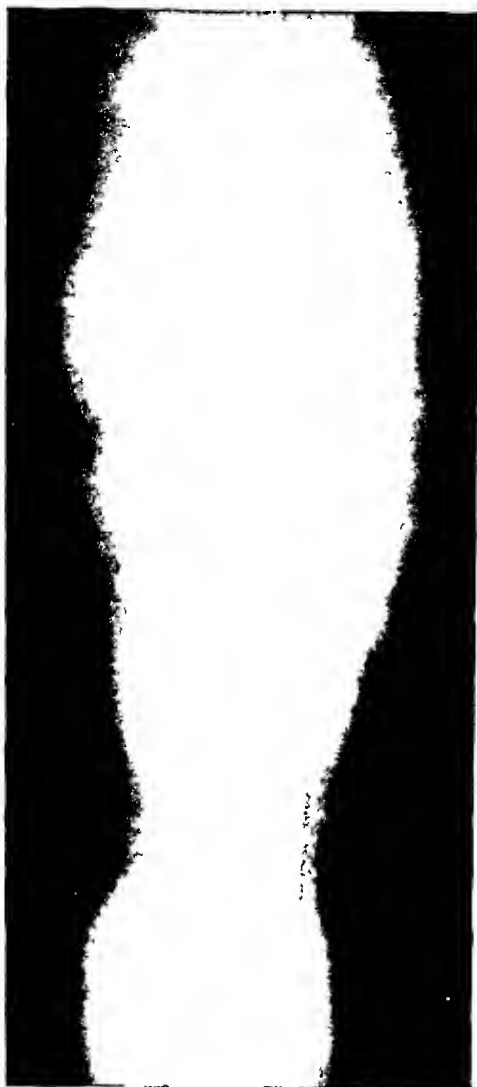


FIG. 2. Showing typical trabeculation of the subcutaneous tissues.

accompanying diuresis and loss of body weight. There was no epidermophytosis of the feet. There was a large hydrocele of the right tunica vaginalis but no edema of the scrotum.

On January 16, 1940, the first-stage operation was carried out through a longitudinal incision from the knee to the foot on the anteromesial aspect of the leg, all the tissue between the skin and the muscle tendons and bone being removed. The subcutaneous tissue was very vascular and extremely hard and sclerosed. The muscles and other subaponeurotic structures appeared normal. The skin flaps were

sutured with fine silk. On January 27th, the second-stage operation was done, on the posterolateral aspect of the leg. After each operation there was a slight elevation of temperature (99 to 100°F.) for two days. The wounds healed well. He was discharged on February 14th wearing an elastic stocking.

He was readmitted on April 28th. He had had no febrile attacks. The leg was much smaller than on the first admission and the patient had a decidedly optimistic outlook. There was so much sweating that the skin of the toes and popliteal space was beginning to show alarming maceration. It was believed hazardous to proceed without first attacking the hyperhidrosis. On May 1st, a right lumbar ganglionectomy was done which abolished sweating of the leg from the upper part of the knee and the lower portion of the thigh. On May 8th, the third-stage operation was performed on the anterolateral aspect of the leg. There was an afebrile and uneventful convalescence. The fourth stage on the posteromesial aspect was carried out on May 22nd. The sural nerve was left intact. The following day the patient was acutely ill. There was diffuse pain throughout the entire right lower extremity and the temperature was 105°F. and the pulse 124. The wound was infected. Cultures grew Beta hemolytic streptococcus and *Bacillus subtilis*. The blood culture was negative. The patient said that he could see no difference between the present difficulty and the numerous spontaneous febrile episodes he had previously had. The wound was separated sufficiently to permit drainage and sulfanilamide was given. The fever began to subside and the wound infection cleared. A small slough had occurred and the defect was covered with small deep pinch grafts on June 10th. He was discharged with the leg well healed on June 30th. He was advised to have the sole of his left shoe raised.

The patient returned for a check-up on March 7, 1941. He was extremely gratified by the result. He had been walking without difficulty and had been regularly working as a laborer in a mill. He had had no febrile attacks. He had been wearing an elastic stocking, which, however, had become so loose and badly worn in the past few months that it offered no support whatever. The leg showed no edema. The thigh, which had formerly been tense and hard, was now much less swollen. Its circumference was, in fact, 10 cm. smaller than before the operations.

In Table I are given measurements of the legs taken at different times. In Figure 3 are shown photographs taken ten months after operation.

were small collections of mononuclear cells about blood vessels. No lymphatic vessels were demonstrable.

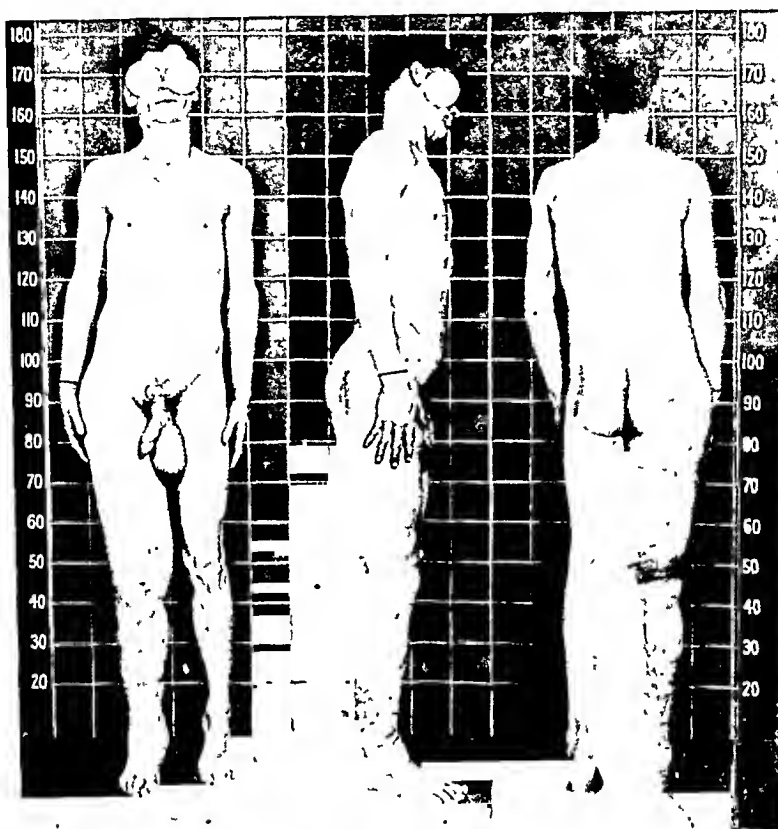


FIG. 3. Photographs taken ten months after operation.

Figure 4 shows the microscopic appearance of the subcutaneous tissue. There was great scarring and some hyalinization of the subcutaneous tissues and numerous small and large blood vessels with thickened walls. There

The patient has continued to do well. It is now nearly two years since the operative treatment was begun. He has had no febrile episodes save the one associated with the postoperative wound infection after the last stage. He has

TABLE I

SHOWING CHANGES IN CIRCUMFERENCE OF THE RIGHT LOWER EXTREMITY

Place at Which Measurements Were Made	Circumference in Centimeters					
	Left	Right				
	1-4-40	1-4-40	1-11-40 After bed rest and elevation of leg	1-12-40 After being up ten hours	4-28-40 On readmission after two stages	3-7-41 Ten months after completion of operation
Malleolus—cm. . .	24	39	35	40	36	32.5
10 above. . . . .	20	41	37	40	32	29
20 above. . . . .	30	51	43	50.5	40.5	36.5
30 above. . . . .	31	50	44.5	49.5	43.2	40
40 above. . . . .	33	46	42.5	45	45.5	43.5
50 above. . . . .	43	54	50	51.5	56.4	47.5
60 above. . . . .	46	58	56.5	56	60.8	52.5

worked constantly at a difficult task requiring long hours of standing.

#### DISCUSSION

This case is an unusual and an interesting one and the result has been most satis-

symptoms were due to a combination of the two conditions, but the symptoms referable to the elephantiasis were particularly disabling.

After numerous unsuccessful attempts by very competent investigators, elephan-

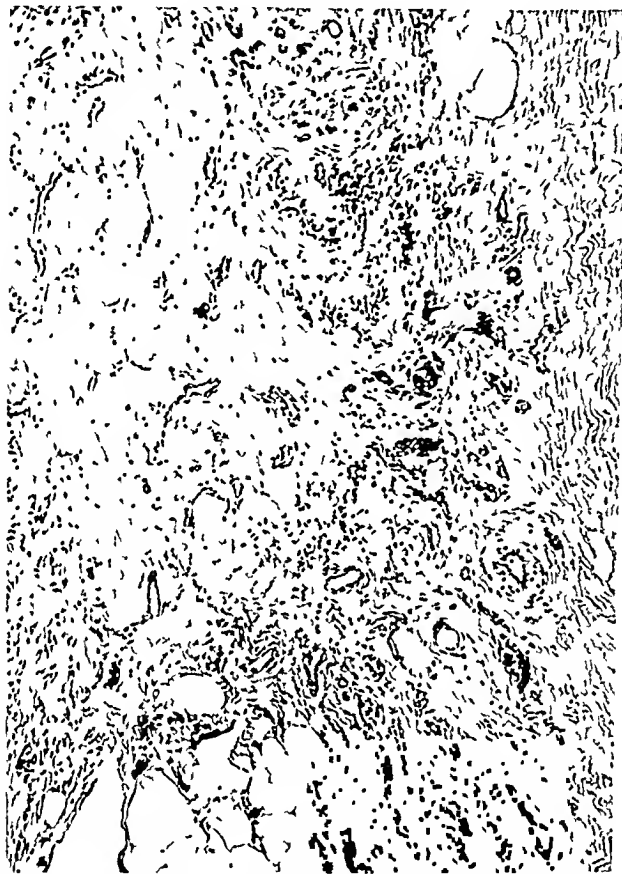


FIG. 4. Microscopic appearance of subcutaneous tissue.

factory. Instead of an ill and discouraged patient with no better prospect than amputation of his leg, a procedure which had been repeatedly urged, he is and has been for two years relatively well and gainfully employed.

One might designate his pathologic process as one of widespread congenital malformation of the subcutaneous structures of the right lower extremity associated with diffuse hemangioma, connective tissue overgrowth, and either maldevelopment of the lymphatics or their destruction from the vascular and connective tissue proliferation. The vascular abnormality caused considerable hypertrophy, the lymphatic deficiency a true elephantiasis. The

tiasis was finally produced in experimental animals by Homans, Drinker and Field.<sup>2 3</sup> After bringing about complete obliteration of the lymphatics by repeated injections of powdered silica and a sclerosing agent, they succeeded in producing a permanent lymphedema in dogs indistinguishable from that seen in human subjects. There were the same hard edema, the same pathologic changes, the spontaneous attacks of elephantiasis fever. These studies permitted an explanation of elephantiasis as a disorder due to a great deficiency of the lymphatic drainage regardless of the etiologic agent. That infection itself is not invariably an etiologic agent was suggested by Homans from these experimental

studies and from the fact that many patients with idiopathic elephantiasis have the lymphedema long before the attacks of elephantiasis fever begin. Such was the case with my patient. During attacks of fever in the dogs, Homans and his co-workers succeeded in recovering streptococci from the edema fluid. That the streptococcus or other pyogenic organism is responsible of the febrile attacks in the patient reported, and no doubt in other cases, is suggested by the fact that a postoperative streptococcal wound infection precipitated an attack which, save for the obvious wound infection, was identical objectively and subjectively with the spontaneous attacks which the patient had had previously. Whether the organisms were in the tissues and multiplied as a result of the trauma of operation or whether they were introduced at operation, I cannot say. Since this episode every patient with elephantiasis has been given one of the sulfonamides before each operation. The dusting of powdered sulfanilamide into the wound before closure might be a useful adjunct.

This operation is the one suggested by Homans and he deserves full credit for this valuable surgical procedure. For though it is technically an extension and outgrowth of the operation devised by Kondoleon<sup>6</sup> and modified by Auchincloss<sup>7</sup> and others, it was conceived and executed for entirely different considerations. The Kondoleon procedure, like many operative procedures before it, was aimed at establishing anastomosis between the diseased superficial lymphatics and the supposedly normal deep lymphatics. What deep lymphatics there are drain, of course, into the same collecting channels as the superficial ones, and these channels are invariably obliterated in elephantiasis. Auchincloss excised wider amounts of subcutaneous tissue in cases of filarial elephantiasis in an effort to remove the "trigger zones" in which he believed the afebrile episodes were initiated. Realizing that there was no hope of re-establishing normal lymphatic drainage, Homans set out with deliberation to

remove in two, three or four operations all the tissues of the leg between the skin and the subaponeurotic structures with a view to removing the tissues in which fluid accumulates. This plastic procedure gives excellent results. Little or no swelling of the leg is present afterward and the febrile attacks ordinarily disappear. The thigh usually requires no operation. A bulky thigh is not the impediment that a heavy swollen leg is. Actually, it usually decreases in circumference after the leg is operated upon, probably because it ceases to have the burden of transmitting the drainage from the tissue soaked leg when the limb is elevated during bed rest. Such has been true in the patient reported. Should he desire at some future date to have the thigh reduced in size, there is no reason why it should not be done. It is believed that the cessation of the excessive sweating, brought about by sympathectomy, was helpful in the treatment of this patient.

#### SUMMARY

A case of a patient with both congenital hypertrophy of a limb and elephantiasis due to a congenital malformation of the subcutaneous tissues with diffuse hemangioma, connective tissue proliferation, and lymphatic insufficiency is reported. The successful operative treatment is discussed.

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# ELEPHANTIASIS OF THE SCROTUM

## CASE REPORT

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**E**LEPHANTIASIS in its urologic sense is a term generally used for a permanently large, bizarre, edematous swelling involving the genitalia, wherein the clinical picture resembles the classical filarial condition, but may in no way be etiologically associated with that disease.

Matas (1913) defines elephantiasis as a progressive histopathologic state characterized by a chronic inflammatory fibromatosis or hypertrophy of the hypodermal and dermal connective tissue, preceded by and associated with lymphatic venous stasis.

The histopathologic elements are: (1) A mechanical obstruction or blockage of the veins and lymphatics of the part, generally a thrombophlebitis, lymphangitis or adenitis; (2) hyperplasia of the collagenous connective tissue of the hypoderm; (3) the gradual disappearance of the elastic fibers of the skin; (4) presence of a coagulable dropsy or hard lymphedema; and (5) chronic reticular lymphangitis due to secondary and repeated invasion by pathogenic micro-organisms of the streptococcal type.

Of the nontropical types of elephantiasis, probably the most common is that caused by the sequelae of lymphopathia venereum. Cases of luetic origin have been reported; congenital types are rare.

## CASE REPORT

The patient, I. W., a white male, aged fifty-one, consulted Dr. E. for the first time on September 14, 1935, complaining of recurrent inflammation of the scrotum associated with pain, tenderness, chills and fever, and with general malaise over a period of twelve years. The family history was irrelevant and there was nothing in the patient's habits or mode of living which in any way bore relationship to his

complaints. There was a history of Neisserian infection thirty years before and a history of pleurisy, tonsillitis and a questionable history of malaria.

The patient had his tonsils and adenoids removed. An operation for inflamed lymph glands in both groins was performed several years ago. This lymphadenopathy was not at the time associated with any sore upon the external genitalia nor any urethral discharge as far as the patient knew. He was told at the time that he had infected lymph glands but no mention was made of the possible etiology. The operative wounds healed without incident and since that time the patient felt well except for the aforementioned recurrent febrile episodes.

The physical examination disclosed a well developed adult, white male, with negative physical findings except for an irregular thin scar in the region of both right and left groins. It was impossible to see the penis because it was buried in a mass, consisting of the scrotum which was intensively swollen and red, and covered with blebs giving much the appearance of erysipelas. Urination disclosed that the penis was buried in this inflammatory mass and attempts to urinate caused the urine to trickle over the inflamed scrotum. There was no evidence of hernia and there was no transillumination through the scrotum. Rectal examination was negative and there was no evidence of any fissures or fistulas.

The urine was straw colored, acid, clear, specific gravity was 1.011, albumin 5 mg., sugar negative, acetone negative, and microscopically there were a few leucocytes per high power field; in other words, there was no evidence of chyluria. The blood Wassermann and Kahn were negative. The hemoglobin was 80 per cent by Dare, erythrocytes 4,700,000, leucocytes 13,000, neutrophils 80 per cent of which segmented forms were 74 per cent and nonsegmented 6 per cent, lymphocytes 15 per cent, monocytes 4 per cent and basophiles 1 per cent. Smears were essentially normal. There was no

evidence of parasites in the blood. Particular search was made to no avail for filarial and malarial parasites.

isolated segment of penis and was forced backward through the entire thickness of the tumor, which was thus separated into two halves. Each

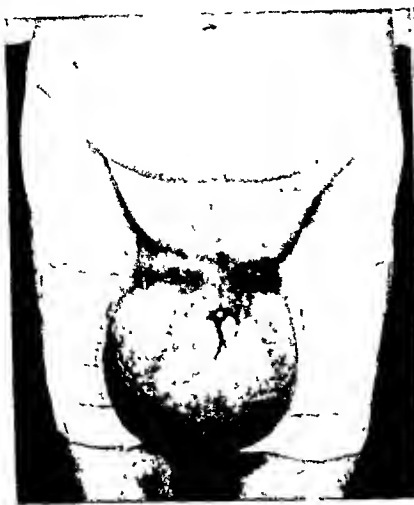


FIG. 1. Elephantiasis of scrotum before operation.



FIG. 2. Appearance day of discharge from hospital.

Clinical diagnosis was made of elephantiasis as a consequence of lymphopathia venereum with recurrent erysipeloid infection of the scrotum causing recurrent febrile episodes.

Operation was performed on October 1, 1935, by Dr. C. The patient was placed in the lithotomy position with the scrotum hanging over the end of the table. A circular incision was made around the neck of the tumor, dividing only skin along with a very small quantity of subcutaneous tissue. A large amputation knife was then thrust proximally under the skin till its point reached the vicinity of one external abdominal ring and with a rapid sawing movement the knife was carried across subcutaneously, until its point reached the opposite ring. An assistant meanwhile reduced bleeding to a minimum by gauze pressure. All bleeding points were then clamped and tied. Thus one-half of a collar-like skin flap was fashioned. The lower one-half of the collar was now freed in a similar way, the point of the knife being held close against the perineum and the adductor origins while the undercutting was performed.

With the skin collar reflected, a one-inch incision was made over the upper part of each spermatic cord, near the external abdominal ring, and also over the root of the penis near the suspensory ligament. A gauze loop was passed around each of the three structures thus exposed and each was isolated at its base. The point of a large clamp was pressed beneath the

half was securely grasped about one inch distally to pubes and perineum by a clamp, the cords and penis being carefully avoided.

The penis and both cords and testes were fully exposed through long vertical incisions and dissected free from the tumor mass. By means of a circular incision around the distal portion of the penis, as much skin as possible was saved so that it might be used subsequently as a complete covering for the penis.

The fibrous covering of the spermatic cords were completely excised until the contained blood vessels were clearly seen.

The hydroceles were treated by eversion, with excision of the sac.

The penis, cords and testes were wrapped in sterile gauze and placed on the lower quadrant.

The amputation of the elephantoid scrotum was completed by a series of short scissor snips and knife cuts proximal to the large clamps. The bleeding points were secured by clamps as they appeared and then ligated. Great care was taken to lay bare the perineal muscles and to divide the line of fusion between Colles' fascia and the two layers of the triangular ligament.

The edges of the skin collar were united along a median vertical line in such a way as to form a new scrotum into which the cords and testes were snugly tucked. A rubber tube was inserted through the lowest end of the suture line and retained for forty-eight hours. The penis was then covered by pulling back over it

the preserved skin of its distal portion, the cut edges of which were fixed by a few points of suture to the edge of the uppermost portion of the skin collar.

Twenty-four hours after the operation the patient developed a massive atelectasis of the left lung. Consequently, his condition for the next few days was critical, but the postoperative course thereafter was uneventful. At the time of discharge from the hospital on October 17, 1935, he had completely recovered.

The patient was last seen about one year ago, in the Spring of 1941. There was no evidence of any recurrence of his former elephantiasis. He had developed a small right direct inguinal hernia. He refused herniorrhaphy stating that he was very happy with the present condition of his scrotum.

Microscopic examination revealed a chronic productive inflammatory fibrosis. Numerous dilated capillaries and lymphatic spaces were seen. There was moderate edema with a distinct separation of the connective tissue fibers. An extensive round cell infiltration with many scattered polymorphonuclear leucocytes was evident.

Culture from the scrotum showed growth of nonhemolytic streptococci and *Staphylococcus albus*.

#### COMMENTS

Clinical observation has shown that if a lymph scrotum develops as a consequence of filarial obstruction, it becomes an elephantiasic scrotum only when repeated attacks of erysipeloid infection follow in the wake of the mechanical stasis, and in this way is initiated the fibromatous process which is the histologic essential elephantiasis.

In view of this history of an operation of suppurative lymphadenitis, the impression

was gained that this patient probably had lymphopathia venereum and that either as a result of the original inflammatory process or as a result of operative interference there had taken place obstruction to the lymphatic drainage of the external genitalia. Due to the lessened resistance to infection with the lymph scrotum, a recurrent lymphangitis became repeatedly superimposed on the resultant lymphedema. The trickling of the urine over the surface of the scrotum was possibly a potential source of the recurrent infection.

#### SUMMARY AND CONCLUSIONS

A case of elephantiasis of the scrotum and penis of undetermined etiology is reported.

Attention is directed to the histopathogenesis of the true elephantiasic state.

The operative treatment of scrotal elephantiasis in this case produced a satisfactory result.

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# PATENT OMPHALOMESENTERIC DUCT

## REVIEW OF THE LITERATURE AND CASE REPORT

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CONGENITAL patency of the omphalomesenteric duct is a rare developmental anomaly eventuating in a fecal fistula at the navel. Arey<sup>1</sup> has described the embryology involved as follows: "The yolk sac of an early human embryo consists potentially of two regions. Its roof is destined to fold off as a tube which becomes the primitive gut. The remainder is the yolk-sac proper, which has no nutritive function but continues to grow into a vesicle somewhat the size of a pea. It may persist throughout pregnancy and appear among the deciduae. The isthmus of yolk-sac tissue connecting gut with yolk-sac proper normally grows at a much slower rate and becomes drawn out into a thread-like duct, the yolk-stalk. This stalk is incorporated into the umbilical cord during the sixth week, but at the same time it usually is also losing connection with the gut. Rapid degeneration and disappearance is the final fate of the normal yolk stalk.

"Nevertheless, in about two per cent of all adults there is some evidence of the persistence of that end of the yolk stalk which originally attached to the intestine. The site is about two feet above the ileocolic valve. Such pouches are named (Meckel's) diverticula of the ileum. Commonly they range in size from a slight elevation on the intestinal wall to finger-like, blind tubes several centimeters long. Much more rarely the original stalk is retained in its entirety between ileum and umbilicus. If patent, it allows intestinal contents to pass outward, whence they may escape through its fistulous mouth. Such retention and patency constitutes an umbilical fistula."

Many variants of the condition have been seen. A truly persistent and patent

duct consists of a fistulous tract completely lined with intestinal-like mucosa joining the terminal ileum to the navel. This, of course, results in the discharge of feces at the umbilicus. The duct may degenerate into a fibrous, cord like structure and persist as such. In these cases there is no fecal fistula and the anomaly is only found at autopsy or when a loop of bowel becomes entangled in the cord causing intestinal obstruction.<sup>2,3</sup>

Persistence of the duct is usually found as a single developmental defect and as such it is amenable to surgical correction. It may, however, be associated with other anomalies which would in themselves be incompatible with life. The clinician is primarily interested in the cases which occur as single defects suitable for correction. Instances of the condition are rare and are usually reported as single cases. We have found no collective review in English since Cullen's work in 1916.<sup>4</sup> We have, therefore, reviewed the cases indexed in medical literature and report another single case.

In all, one hundred five cases of persistent patent omphalomesenteric duct have been reported. While a few of these had concomitant congenital defects, such as umbilical herniae, none is included in which the conditions present precluded the possibility of continued existence. A few which were found at autopsy on premature infants are included. The sum of Tables I, II, III and IV gives a complete bibliography. The composite clinical history was briefly as follows: The babies were usually full term, healthy infants. At the time of birth it was often, though not invariably, noticed that the umbilical cord near the navel was abnormally large. When the umbilical cord

sloughed off, a small, cherry-red tumor about  $\frac{1}{2}$  cm. in length was left at the navel. This was frequently thought to be granulation tissue. However, at the apex of the tumor there was a small opening into which a probe could be passed several centimeters. Fecal material soon began to dis-

tract. This occurred twenty-six times or in approximately one-fourth of the collected cases. These are listed in Table I. In twelve of these cases operative treatment was attempted. Three are reported as surviving the operation. In one of these (Crymble, P. T.,) there was only partial prolapse of

TABLE I  
CASES IN WHICH PROLAPSUS OCCURRED

Author	Reference	No. of Case	Treatment	Outcome
Arndt, C.....	<i>Arch. f. Gynäk.</i> , 52: 71, 1896	Case 1	Operation	Death
Barth, A.....	<i>Deutsche Ztschr. f. Chir.</i> , 26: 193, 1887	Case 1	Operation	Death
Basevi, Settimio.....	<i>Jahrb. f. Kinderheilk.</i> , 12: 275, 1878	Case 1	No operation	Death
Blin.....	<i>Mém. de la Soc. de biol.</i> , Paris, 55: 131, 1853	Case 1	No operation	Death
Clamann.....	<i>Deutsche med. Wchnschr.</i> , 28: 416, 1902	Case 1	No operation	Death
Cooper, Percy R.....	<i>Clin. J.</i> , 47: 78, 1918	Case 1	Operation	Death
Crymble, P. T.....	<i>Brit. J. Surg.</i> , 9: 304, 1921	Case 1	Operation	Death
Cutler, George David.....	<i>Boston M. &amp; S. J.</i> , 190: 782, 1924	Case 1	Operation	Recovery?
Gesenius.....	<i>J. f. Kinderkrankh.</i> , 25: 56, 1858	Case 1	No operation	Death
Golding-Bird, C. H.....	<i>Clin. Soc. Tr.</i> , 29: 32, 1896	Case 1	No operation	Death
Guthrie, L. G.....	<i>Pediatrics</i> , 2: 1, 1896	Case 1	No operation	Death
Helweg, Kr.....	<i>Hospitals tid.</i> , 2: 705, 1884	Case 1	Operation	Death
Holmes, T.....	<i>Surgical Treatment of the Diseases of Infancy and Childhood</i> . London, 1868	Case 1	No operation	Death
Hue, Francois.....	<i>La Normandie méd.</i> , 21: 162, 1906	Case 1	No operation	Death
Hüttenbrenner, A.....	<i>Allg. Wien. med. Zeitung</i> , 23: 225-235, 1878	Case 1	Operation	Death
King, T. W.....	<i>Guy's Hosp. Rep.</i> , 2: 467, 1843	Case 1	No operation	Spontaneous reduction; recovery
Kölbing, A.....	<i>Neue Zeitschr. f. gebursk.</i> , 14: 443, 1843	Case 1	Operation	Death
Löwenstein, L.....	<i>Langenbeck's Arch. f. klin. Chir.</i> , 44: 541, 1894-95	Case 1	Operation	Death
Ophüls, W.....	<i>Inaug. Diss.</i> , Göttingen, 1895	Case 1	Operation	Death
Ott, I.....	<i>Riforma med.</i> , 45: 615, 1929	Case 1	Operation	Death
Rosenbaum, L.....	<i>Altona</i> , 1891	Case 1	No operation	Death
Siebold. Quoted by G. Schröder.....	<i>Inaug. Diss.</i> , Augsburg, 1854	Case 1	No operation	Death
Théremin, E.....	<i>Rev. mens. d. mal. de l'enf.</i> , 558, 1885	Case 1	No operation	Death
Théremin, E. Loc. cit.....	<i>Rev. mens. d. mal. de l'enf.</i> , 558, 1885	Case 1	No operation	Spontaneous reduction; recovery
Violbing. Quoted by Bureau.....	<i>Thèse de Paris</i> , 1898. No. 257	Case 1	No operation	Death
Weinlechner.....	<i>Jahrb. f. Kinderb.</i> , 8: 55, 1874	Case 1	Operation	Death

charge through this opening. The amount of drainage varied from an occasional soiling, occurring only when the bowels were loose, to a continuous discharge of feces. Most of the children ate well and developed normally unless some unfortunate circumstance intervened.

The most common and most dangerous complication reported was eversion or prolapse of the ileum through the fistulous

tract. This occurred twenty-six times or in approximately one-fourth of the collected cases. These are listed in Table I. In twelve of these cases operative treatment was attempted. Three are reported as surviving the operation. In one of these (Crymble, P. T.,) there was only partial prolapse of the duct and not true eversion of the ileum. In another, (Cutler, G. D.), the child is reported as surviving the operation but it died of erysipelas and pneumonia before leaving the hospital. In the fourteen cases of prolapse in which no operation was attempted, spontaneous reduction occurred twice and the children survived. All the rest died of intestinal obstruction. The mortality rate for the entire group was,

therefore, about 80 per cent. In fairness it should be said that many of these cases were reported before the advent of modern surgical technic. The complication is, however, extremely dangerous. Eversion or prolapse occurred any time from four hours after birth to two years of age but was most frequent at about five months. It occurred most often during a fit of coughing or crying. The prolapse appeared as a

the slough occurred, drained large quantities of fecal material from the navel and the symptoms of obstruction disappeared.

Treatment of patent omphalomesenteric duct, as with most surgical conditions, has varied through the years. In 1873, MacSwiney of Dublin answered a call to see a boy seven years of age and found an *ascaris lumbricoides* emerging from an opening at the navel. He responded to the emer-

TABLE II  
CASES FOUND AT AUTOPSY OR IN WHICH NO MENTION IS MADE OF TREATMENT

Author	Reference	No. of Case	Details
Garratt, J R	<i>Brit. M. J.</i> , 1: 645, 1918	Case 1	Occurred in identical twins; no treatment mentioned
		Case 2	
Hickman	<i>Tr., Patb. Soc. London</i> , 20: 418, 1869	Case 1	No treatment mentioned
Holmes, T	<i>Surgical Treatment of Diseases of Children</i> . London, 1868	Case 1	No treatment mentioned
MacSwiney, S M	<i>Proc. Patb. Soc., Dublin</i> , 6: 251, 1873-75	Case 1	No treatment mentioned
Parker, C H	<i>Am. J. Roentgenol.</i> , 10: 607, 1923	Case 1	No treatment mentioned
Poussin	<i>J. de med.</i> , 40: 81, 1817	Case 1	No treatment mentioned
Auslander, Milton M. and McClure, Laura	<i>Am. J. Dis. Child.</i> , 40: 1276, 1930	Case 1	Autopsy specimen
Auvard	<i>Trav. d'obstet.</i> , 1: 331, 1889	Case 1	Autopsy specimen
Bridgeman, M. L. and Menne, Frank R	<i>Am. J. Dis. Child.</i> , 42: 602, 1931	Case 1	Autopsy specimen
Brindeau	<i>Février</i> , 25: 45, 1895	Case 1	Autopsy specimen
Broadbent	<i>Med. Times &amp; Gaz.</i> , 2: 45, 1866	Case 1	Autopsy specimen
Fitz, R	<i>Am. J. Med. Sc.</i> , 88: 30, 1884	Case 1	Autopsy specimen
Leisrink and Alsberg	<i>Arch. f. klin. Chir.</i> , 28: 768, 1882	Case 1	Autopsy specimen
Prestat. (Quoted by Ledderhose)	<i>Deutsche Chir.</i> , lief. 45 b., 1890	Case 1	Autopsy specimen
Roth, M	<i>Virchows Arch.</i> , 86: 371, 1881	Case 1	Autopsy specimen
Schroeder, G	Inaug. Diss. (Erlangen), Augsburg, 1854	Case 1	Autopsy specimen
Wilks, Samuel	<i>Tr. Patb. Soc., London</i> , 16: 126, 1865	Case 1	Autopsy specimen

red, sausage-like tumor lying across the abdomen and attached by its middle to the navel. Symptoms of intestinal obstruction rapidly appeared and unless the condition was relieved, death followed.

The only other condition causing a fecal fistula at the navel was the application of the cord tie to a loop of bowel present in an umbilical hernia. When the cord tie sloughed through, a direct communication was left between bowel and the outside. Such cases were easily differentiated by their clinical course. Symptoms of intestinal obstruction appeared soon after the tie was applied. Those who lived until

agency as follows, "I at once proceeded to deliver it in an artistic way, and I had to exercise some caution in the operation lest it should break as there was considerable tension on the creature, and it was evident that its body was tightly compressed in a tract or sinus through which it was slowly making its way out." The "delivery" successfully accomplished, the doctor mentioned no further treatment. Table II lists eighteen such cases in which no specific treatment was mentioned or which were found at autopsy. During the nineteenth century, efforts were made to close the fistulous tract by applying caustics, cur-

retting it or ligating the umbilical tumor. Reports of nineteen such cases are listed in Table III. These early surgical methods met with a fair measure of success in at least stopping the fecal discharge. With the advent of modern surgery, reports of the radical removal of the entire sinus tract

The report of a case of patent omphalo-mesenteric duct observed from birth through successful operation follows:

### CASE REPORT

On February 14, 1937, I delivered the patient at Evangelical Deaconess Hospital. It

TABLE III  
CASES TREATED CONSERVATIVELY OR BY LIGATURE, CAUSTICS, CURETTAGE OF THE TRACT OR OCCLUSION APPARATUS

Author	Reference	No. of Case	Treatment	Outcome
Billroth.....	<i>Chir. Klin.</i> , 294, 1869	Case 1	Ligature	Healed
Brun, L. A.....	Thèse de Paris, No. 238, 1834	Case 1	Ligature	Healed
		Case 2	Ligature	Healed
		Case 3	No details	
Eves, A.....	<i>Lancet</i> , 1: 101, 1845	Case 1	Ligature	Healed
Gampert.....	<i>Rev. méd. de la Suisse Rom.</i> , 13: 356, 1893	Case 1	Cautery and ligation	Healed
Hansen, J. A.....	Inaug. Diss., Kiel, 1885	Case 1	Tumor removed and skin closed	Healed
Jacobi, A.....	<i>New Yorker med. Monatsschr.</i> , 14: 273, 1902	Case 1	Occlusion apparatus	Healed
Kučerová, D.....	<i>Časop. lékař. česk.</i> , 74: 547, 1935	Case 1	Conservative	Spontaneous closure
Marshall.....	<i>Med. Times &amp; Gaz.</i> , 2: 640, 1868	Case 1	Dissected mucous membrane and closed wound	Healed
Pernice, L.....	<i>Die Nabelgeschwülste</i> , Halle, 1892	Case 1	Tract curetted	Healed
Pratt, J. W.....	<i>Lancet</i> , 2: 1142, 1884	Case 1	Ligature	Healed
Quaet-Faslem.....	Inaug. Diss., Kiel, 1899	Case 1	Removal of tumor and suture	Healed
		Case 2	Removal of tumor and suture	Healed
		Case 3	Removal of tumor and suture	Healed
Railton, T. C.....	<i>Brit. M. J.</i> , 1: 795, 1893	Case 1	Tumor removed and wound sutured	Healed
Sánchez, Santiago.....	<i>Arch. de med. inf.</i> , 5: 275, 1936	Case 1	Conservative	Death
Weiss, Eduard.....	Inaug. Diss., Giessen, 1868	Case 1	Repeated applications of caustic	Healed
Wernher. Cited by Weiss, Eduard.....	Inaug. Diss., Giessen, 1868	Case 1	Caustics	No healing

began to appear in about the year 1890. Forty-two such cases are listed in Table III with five deaths. At present the only question of treatment is when to operate. Some prefer to wait until the child is about one year of age. Others believe that the danger of eversion of the ileum through the fistula outweighs the danger of operating on an infant only a few weeks of age.

was the mother's fourth pregnancy. Labor came on at term and was quite rapid. A male baby weighing seven and one-half pounds was born spontaneously. He appeared normal and cried immediately. Nothing unusual was noted about the umbilical cord which was tied with the tape in use at that time.

The mother's hospital course was uneventful. She did not have sufficient breast milk and the baby was given an evaporated milk and Karo

syrup formula which it took readily. When the cord sloughed off on the ninth day there was a small bud of what was thought to be granula-

At that time the baby seemed to be in excellent general condition and showed no evidence of distress. He was taking his formula well and

TABLE IV  
CASES HAVING RADICAL RESECTION

Author	Referencee	No. of Case	Treatment	Outcome
Alsberg.....	<i>Deutsche med. Wchnschr.</i> , 18: 1040, 1892	Case 1	Resection	Recovery
Ardouin, P.....	<i>Arch. prov. de chir.</i> , 17: 1, 1908	Case 1	Resection	Recovery
Broca.....	<i>Rev. d'orthop.</i> , 6: 47, 1895	Case 1	Resection	Recovery
Broca (Quoted by Bureau, J.)....	Thèse de Paris, No. 257, 32, 1898	Case 1	Resection	Recovery
Caldbeck, S. L.....	<i>Surg. Clin. North America</i> , 8: 1341, 1928	Case 1	Resection	Recovery
Cavazzani, T.....	<i>Gazz. d. osp.</i> , 21: 472, 1900	Case 1	Resection	Recovery
DeLucia, A. E.....	<i>Ann. di. med. nav. e colon.</i> , 2: 315, 1916	Case 1	Resection	Recovery
Eid, F. L.....	<i>Canad. M. A. J.</i> , 23: 676, 1930	Case 1	Resection	Recovery
Froelich, R.....	<i>Rev. mens. d. mal. de l'ens.</i> , 20: 517, 1902	Case 1	Resection	Recovery
Gevaert, G.....	<i>Ann. de méd. et de chir.</i> , 4: 1, 1892	Case 1	Resection	Recovery
Kehr, H.....	<i>Deutsche med. Wchnschr.</i> , 18: 1166, 1892	Case 1	Resection	Recovery
Kern.....	<i>Beitr. z. klin. Chir.</i> , 19: 353, 1897	Case 1	Resection	Recovery
Kirmisson, E.....	<i>Rev. d'orthop.</i> , 12: 321, 1901	Case 1	Resection	Recovery
König, P.....	<i>Therap. Rundschau</i> , 2: 679, 1908	Case 1	Resection	Recovery
Körte.....	<i>Deutsche med. Wchnschr.</i> , 24: 321, 1898	Case 1	Resection	Recovery
Lamare, J. P., Courtois, J. and Isidor, P.....	<i>Gynécologie</i> , 37: 193, 1938	Case 1	Resection	Recovery
J. Leveuf, R. Leroux, and A. Perrot	<i>Ann. d'anat. path.</i> , 12: 1915, 1935	Case 1	Resection	Recovery
		Case 2	Resection	Recovery
		Case 3	Resection	Recovery
J. G. Montgomery, H. M. Gilkey, F. B. Kyger and W. L. Jennings.	<i>J. Missouri M. A.</i> , 35: 244, 1938	Case 1	Resection	Recovery
Morian.....	<i>Langenbeck's Arch. f. klin. Chir.</i> , 58: 306, 1899	Case 1	Resection	Recovery
Muresanu, E.....	<i>Cluj. med.</i> , 9: 158, 1928	Case 1	Resection	Recovery
Neurath, Rudolf.....	<i>Wien. klin. Wchnschr.</i> , 9: 1158, 1896	Case 1	Resection	Recovery
O'Neil, W. E.....	<i>Surg. Clin.</i> , Chicago, 3: 541, 1919	Case 1	Resect on	Recovery
Park, Roswell.....	<i>M. Fortnightly</i> , 9: 9, 1896	Case 1	Resection	Recovery
Pautienis, K.....	<i>Medicina, Kaunas.</i> , 18: 1002, 1937	Case 1	Resection	Recovery
de Planque, P. M.....	<i>Nedrl. tijdschr. u. geneesk.</i> , 1: 3177, 1928	Case 1	Resection	Recovery
Quaet-Faslem.....	<i>Inaug. Diss.</i> , Kiel, 1899	Case 4	Resection	Recovery
Ratnayeke, May.....	<i>Brit. J. Surg.</i> , 24: 402, 1936	Case 1	Resection	Recovery
Robinson, H. B.....	<i>Lancet</i> , 1: 302, 1902	Case 1	Resection	Recovery
Rupp, A.....	<i>München. med. Wchnschr.</i> , 58: 85, 1911	Case 1	Resection	Recovery
Ryadnov, S. M.....	<i>Sovet. Klin.</i> , 20: 143, 1934	Case 1	Resection	Recovery
Salzer, H.....	<i>Wien. klin. Wchnschr.</i> , 17: 614, 1904	Case 1	Resection	Recovery
Semb, O.....	<i>Norsk mag. F. lægevidensk.</i> , 83: 778, 1922	Case 1	Resection	Recovery
Shepherd, F.....	<i>Arch. Pediat.</i> , 9: 55, 1892	Case 1	Resection	Recovery
Stierlin, R.....	<i>Deutsche med. Wchnschr.</i> , 23: 188, 1897	Case 1	Resection	Recovery
Strater, M.....	<i>Deutsche Ztschr. f. Chir.</i> , 74: 143, 1904	Case 1	Resection	Recovery
Battle, W. H.....	<i>Clin. Soc. Tr.</i> , London, 26: 237, 1893	Case 1	Resection	Death
Deschin.....	<i>Centralbl. f. Chir.</i> , 22: 1154, 1895	Case 1	Resection	Death
Most, A.....	<i>Beitr. z. klin. Chir.</i> , 144: 236, 1928	Case 1	Resection	Death
Rosenblum, L.....	<i>Altona</i> , 1891	Case 1	Resection	Death
Sauer, Felix.....	<i>Deutsche Ztschr. f. Chir.</i> , 44: 316, 1896	Case 1	Resection	Death

tion tissue present at the navel. No discharge was noted from this area while at the hospital. Shortly after going home on the tenth postpartum day, the mother noticed that there was a discharge from the navel which looked like bowel content. We were notified immediately.

was gaining weight. His bowels had been moving per rectum. There was a small red bud of tissue about  $\frac{1}{2}$  cm. in length protruding from the navel. At the apex of this bud there was a minute opening from which a small amount of liquid was occasionally ejected. This discharge

appeared to be bowel content. The skin around the navel was normal and there was no evidence of infection. The condition was considered due,



FIG. 1. Patient's abdomen showing bud protruding from the navel.

most probably, to a persistent patent omphalo-mesenteric duct. This was explained to the parents and developments were awaited. A bland ointment dressing was kept over the navel and the skin about it was kept clean.

The child was next seen when he was six weeks of age. He was in excellent health and was gaining weight rapidly. He was having normal bowel movements per rectum. The navel appeared about the same as it had before. The small red tumor was covered with mucosa-like tissue. It did not bleed easily on manipulation as one would expect if it were simply granulation tissue. There was no evidence of discharge at the time I saw it. The mother stated, however, that both feces and gas came out through the opening. She had noted that the occurrence of the discharge was dependent upon the condition of the baby's bowels. If the child was kept rather constipated, there might be no discharge for several days. If the bowels were loose, the discharge occurred almost continuously. Since development proceeded normally, a conservative course was followed until he was about one year of age. When seen in the office at that time his development had been excellent except for delayed dentition. He was now on an almost general diet, still avoiding foods which had a laxative effect. There was still intermittent discharge of bowel content and gas from the navel. The family history was entirely negative for cancer, tuberculosis or diabetes. There was no history of any other congenital defects or abnormalities.

Physical examination at this time showed the patient to be an unusually well developed and robust little boy. His weight was twenty-three pounds. He was in good physical condition and was mentally active. The abdomen was rounded and of normal contour for an infant one year old. It was everywhere soft and flaccid. There was no evidence of tenderness. There was no rigidity and there was no palpable masses. There was a small, moist, rounded, cherry-red bud protruding about  $\frac{1}{2}$  cm. from the navel. (Fig. 1.) This small mass was covered with what appeared to be intestinal mucosa which was continuous with the skin of the abdomen all around its edge. The skin about the navel was normal, clean and in a healthy condition. At the apex of the bud there was a small opening into which a probe could be introduced and passed downward and to the right for about  $3\frac{1}{2}$  cm.

One especially interesting fact was noted: If one watched the abdomen for some time, changes occurred in the contour of the bud at the navel. At times it would stand up, become tense, and protrude for a distance of almost 1 cm. At other times it would slowly draw inward until it almost disappeared from view. The navel dimple would then appear almost normal. This change in contour took place slowly and gradually. It was interpreted as being due to peristalsis. Whether there was actually smooth muscle out at the navel or whether the phenomenon was due to a pull on the navel from the normal peristalsis in the gut could not be determined.

Examination of the blood showed hemoglobin and cellular content to be normal. Fluoroscopic and x-ray examination was performed at our office. A blunt cannula was introduced about 1 cm. into the opening at the navel and a small quantity of thick barium solution injected. The barium could be seen to traverse a small tract running downward, inward and to the right. This tract appeared to be about 5 or 6 cm. in length. From it, the barium could be seen to enter coils of small intestine. Just where the fistulous tract joined the gut could not be definitely determined. However, the juncture was affected in the right lower quadrant of the abdomen, an area usually occupied by loops of terminal ileum. Also, when the barium, which had just entered the small intestine through the fistula, was observed fluoroscopically at five minute intervals, it could be seen to enter the cecum within a few

minutes. This would also indicate that the tract joined the small intestine in the lower part of the ileum. X-ray plates taken in

The tract had no mesentery but lay free in the peritoneal cavity. It received its blood supply from one large vessel from the mesentery of the



FIG. 2. Lateral x-ray showing fistulous tract.

anteroposterior and lateral positions confirmed the fluoroscopic findings. (Fig. 2.) A diagnosis of fistulous tract from the navel to the small intestine due to persistent patent omphalo-mesenteric duct was made and surgical closure was advised.

The patient was operated upon at Evangelical Deaconess Hospital, February 21, 1938. A transverse elliptical incision was made about the navel and carried down to the peritoneum. The peritoneal cavity was entered just above the navel. This incision was carried around the navel, completely freeing it. When the navel was lifted up, there was a rather thin, fibrous cord attached to its peritoneal side. As this cord was followed downward it became larger in diameter and assumed the appearance of bowel. After extending downward and to the right for about 8 cm. it joined at right angles the antimesenteric border of a loop of small bowel which lay in the right lower quadrant of the abdomen. By the time the fistulous tract joined the bowel it had become almost as large as the gut itself and identical in appearance.

bowel which extended completely across the bowel and out the fistulous tract. This vessel was ligated and the fistulous tract was amputated with the cautery beyond a clamp.

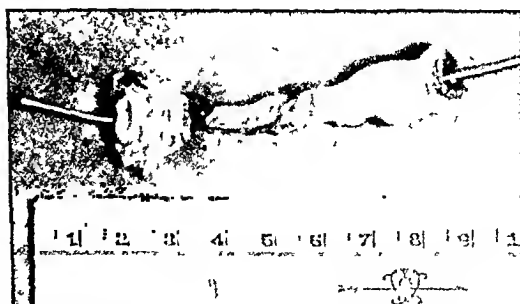


FIG. 3. Resected fistulous tract with probe protruding from navel.

(Fig. 3.) The defect in the bowel was closed transversely with a running Lembert suture. Care was taken not to impinge upon the lumen of the bowel. The abdominal wall was closed in layers much as one would repair an umbilical hernia. No drainage of the peritoneal cavity

was instituted. The patient's postoperative course was uneventful except for the eruption of two upper incisors. He left the hospital on the fifteenth day.

Microscopic description of the excised specimen by Dr. Francis Bayless was as follows: "Sections of the Meckel's diverticulum show a mucosal surface typical of the ileum. No heterotopic gastric mucosa is seen and there are no other abnormalities. Sections from different portions of the passage leading to the umbilicus show that there is well developed and intact muscularis, submucosa and mucosa throughout, and that there is an abrupt transition from mucosa to stratified squamous epithelium at the umbilical orifice."

#### COMMENT

While our case closely followed the composite picture of the condition, there was one point which we considered of special interest. As noted in the history, prolonged observation of the bud at the navel showed that it changed shape. At times it seemed to erect and protrude for almost a centimeter. Again it drew down into the abdomen and almost disappeared. Since

smooth muscle was demonstrated microscopically all the way out the tract, this changing contour was probably due to peristalsis in the tract and navel bud itself. We have never found this sign mentioned in the literature on the subject. It should be a helpful diagnostic point in differentiating between a bud of simple granulation tissue and the tumor of a patent omphalomesenteric duct.

#### CONCLUSION

The literature pertaining to patent omphalomesenteric duct is reviewed and a case\* is reported.

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\* This case was studied in the office of Dr. S. J. Webster.



# MALIGNANT CARCINOID TUMORS OF THE GASTROINTESTINAL TRACT\*

## CASE REPORT

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CARCINOID or argentaffine tumors of the gastrointestinal tract are comparatively rare. They are seldom if ever diagnosed preoperatively but yet may be the cause of the common clinical conditions of appendicitis and bowel obstruction. The incidence of one in every two to five hundred appendices removed surgically or 0.2 to 0.5 per cent has been reported. They have been found less frequently in the large bowel, stomach or duodenum. There were seventy-two carcinoids of the appendix in a group of 26,384 surgically removed appendices or an incidence of 0.28 per cent reported in a review of the pathological material at the Boston City Hospital from 1900 to 1937. In this same period there were two carcinoid tumors of the stomach, one of the gall-bladder, one of the duodenum and eight of the small bowel. None of the appendiceal tumors were malignant.

### SYMPTOMATOLOGY AND PROGNOSIS

Carcinoids of the appendix are usually found between the ages of twenty and thirty. They may give symptoms of vague persistent lower abdominal pain similar in nature to the so-called chronic appendicitis. Carcinoids of the stomach or colon are more likely to be malignant. If they are of the obstructive type, they may be noticed early and surgically treated. If not, they may go on and become widespread before treatment. When present in the bowel they are more likely to be found around the ages

of fifty to sixty years. A carcinoid tumor of the appendix is unlikely to recur after removal of the appendix.

### GROSS AND MICROSCOPIC STRUCTURE

These tumors, often found first at autopsy, appear as small, firm, circumscribed nodules from  $\frac{5}{10}$  to 1 cm. in diameter. They are situated in the submucosa and muscularis and are covered with smooth mucosa and thickened peritoneum. In the appendix the tip is generally bulbous and obliterated. The cut surface is pale yellow with interlacing strands of tissue. When the tumor has extended into the serosa, adhesions between the adjacent surfaces produce a knuckling or kinking of the bowel which leads to obstruction. Large tumors may protrude into the gut or peritoneum or infiltrate the surrounding tissues. (Fig. 1.) The gross specimen has a rubbery feel.

The microscopic picture presents groups of flask-like epithelioid cells with large round, vesicular nuclei. Cell boundaries are often indistinct. The cytoplasm contains granules which are distinctly outlined and which are yellowish in color when fresh and stain black with silver ammonium oxide. The cells are arranged in small groups, indistinctly acinar or in broader cords, or at times in palisade form. These groups of cells are surrounded by a definite fibrous stroma. (Fig. 2.) The uniform size, regular position, opacity and lack of hyperchromatism indicate moderate malignancy. The

\* From the Milwaukee County Hospital, Department of Surgery, Wauwatosa, Wisconsin.

structure of the cells recall the features of low grade melanoma or basal cell carcinoma.



FIG. 1. Gross specimen showing a carcinoid tumor projecting from the stump of the appendix into the lumen of the cecum. 1, the cecum has been partially bisected from the outside and the edges everted showing the mucosa of the cecum. 2, the appendix was short and thick and appears as though the tip had eroded away. The point of section is just below the arrow and shows a fan-like tumor protruding from the stump of the appendix. 3, the other half of the tumor corresponding to that previously described. 4, a mesenteric node which when sectioned showed the same type of tissue both grossly and microscopically as the original tumor. 5, peritoneal surface of the wall of the large bowel.

#### MALIGNANT OR BENIGN?

Formerly, carcinoid tumors were considered to be perfectly benign. However, it is safe to say that they are potentially malignant. If allowed to grow unmolested, they eventually break through their barriers and infiltrate the mesentery. From there they may metastasize to lymph-nodes, liver or to both. Up to 1934, Bailey had collected seven cases of malignancy of carcinoid tumors of the appendix from the

literature. To July, 1939, sixty-seven malignant argentaffinomas or carcinoid tumors of the intestine had been reported in the literature. Latimer (1941) gives the total number reported as seventy-six which includes three cases of his own. In this series fourteen involved the appendix proper. (Fig. 3.)

#### ORIGIN OF CARCINOID CELLS

Langhans, in 1867, described a small polypoid tumor involving the submucosa and the muscularis of the ileum. This presented the alveolar and infiltrating structure now clearly recognizable as that of the typical carcinoid. A clear distinction was made by Lubarsch in 1888 between carcinoids and ordinary adenocarcinoma, although he traced the origin of carcinoids to the crypt cells. Masson states that he was able to convince himself in all of his specimens that the carcinoid cell columns had resulted from proliferation of the intranervous argentaffine cells of neurocrine type. These cells piled up in the nerve fibers, finally ruptured their sheaths, infiltrated the intestinal tissue of the neuroma and then spread to the submucosa. These neurocrine cell proliferations in the connective tissue assume the characteristic appearance of carcinoid cells. Raiford thinks that the cells are of ectodermal origin which have migrated early in life from the neural crest and became adopted to the specific function in forming a part of the general chromaffin system. In favor of this mode of origin is the striking similarity of the cells of certain of these tumors to those of the adrenal gland, not only in morphology but also in the gross color of the tumor. It is known that an affinity for silver, which is exhibited by these tumors and which is not present in epithelial cells, is possessed by many cells of ectodermal origin. The rosettes in typical carcinoids may link them to the neuroblastomas. It might be said at present that most pathologists now agree with Masson that the carcinoid cell takes its origin from Kultschitsky cells found in the base of the

crypts of Lieberkühn. These crypts or glands are found between the villi lining the gastrointestinal tract.

lymphadenopathy at this time. No fecolith could be palpated in the appendix. The appendix was left *in situ*.



FIG. 2. Photomicrograph (high power) of the original tumor. Note indistinct acinar formation.



FIG. 3. Photomicrograph (low power). Section taken from the mesenteric lymph-node. Note similarity of structure to that of the original tumor.

#### CASE REPORT

The following is a case of a carcinoid of the appendix extending into the cecum and metastasizing to the regional nodes:

The patient was a white, twenty-five year old housewife, who was admitted to the gynecological service at the Milwaukee County Hospital and three days later submitted to a left oophorectomy. At the completion of the oophorectomy the appendix was palpated and was found to be short and thick, measuring but about three-fourths of an inch in length. At the base of the appendix a small irregular nodule was palpated through the cecal wall. The mass was movable but was apparently attached at the base. The nodule was felt to be about one-half to three-fourths of an inch in diameter. The lumen of the cecal mass felt ample about the nodule. The ileum appeared normal and there was no apparent regional

Convalescence was relatively uneventful and the patient was discharged on the eleventh postoperative day. After consultation with the general surgical department, the patient was instructed to return for an exploratory laparotomy when the period of convalescence was over.

On detailed questioning the patient denied ever having any gastrointestinal complaints, although she did admit noticing a slight amount of bright red blood on defecation in a few instances which she attributed to hemorrhoids.

On September 11, 1940, the patient was readmitted for an exploratory laparotomy. Physical examination at this time was essentially negative. No mass could be palpated in the abdomen. Rectal and proctoscopic examinations to the eight-inch level were negative.

A resection of the cecum, lower one-third of the ascending colon and six inches of the

terminal ileum was done together with the removal of the involved mesenteric lymph-nodes. The continuity of the bowel was established by a side-to-side anastomosis under spinal anesthesia supplemented with ethylene. The abdomen was closed without drainage. The operative impression was that of a probable malignancy of the cecum.

On examining the gross specimen the cecal wall appeared normal except for some scarring about the serosa. The appendix was short and thick, measuring  $2\frac{1}{2}$  cm. in length. At its base and projecting into the cecum there was a rounded cauliflower-like mass which measured  $5$  by  $3\frac{1}{2}$  by  $2\frac{1}{2}$  cm. This mass was spongy to rubbery in consistency and was light yellow in color. The center was somewhat softer than the periphery. Several small nodes were found in the mesentery and about the cecum, the largest of which measured 1 cm. in diameter. This node had the color and consistency similar to the original tumor. Sections taken from both the tumor and the lymph-nodes for microscopic examination showed the specimen to be a carcinoid tumor with metastasis to the regional nodes. (Fig. 1.)

The postoperative course was relatively uneventful and the patient was discharged on the twelfth postoperative day. The patient has been seen at monthly periods since her discharge. Until the second monthly interval she complained of a mild diarrhea, some rectal tenesmus and a rather sudden urge to defecate which was quite severe and hard to control. However, at the third and fourth monthly intervals, the patient stated that she felt good, her weight was within normal limits and that she had been doing her regular housework. She further stated that her bowel habits were approaching the regularity she had before the operation.

#### SUMMARY

1. This is the report of a case of a carcinoid or argentaffine tumor growing from the stump of the appendix into the

cecum with metastases to the regional lymph-nodes.

2. This adds another case to the seventy-six previously reported malignant carcinoid tumors.

3. All carcinoid tumors should be considered potentially malignant.

4. It is interesting to note that the patient was entirely asymptomatic as far as any gastrointestinal disturbance was concerned even though the tumor had already metastasized to the regional nodes.

I wish to express my appreciation to Dr. Joseph M. King, clinical director of the Department of Surgery and to Dr. J. C. Grill, director of the Department of Pathology at the Milwaukee County Hospital for their kind and valuable assistance in preparing this report.

I also wish to thank Mr. Leo Massopust; Mr. E. T. Satory and Miss Louise Meade for their photographs of the pathological specimens.

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# PERICHONDRAL ARTHROPATHY OF THE KNEE JOINT

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**T**HIS report is based upon a study of more than fifty injured knee joints, each disclosing a derangement which so far has not been reported in literature.

The derangement briefly is the elevation or stripping of the articular capsule which fits over the cartilage coated ends of the bones of the femoral condyles. This phenomenon is associated with an acute exudative synovitis and often leads to a degeneration of the articular cartilage. The condition is due to a direct blow or twist of the knee joint during an attempt at sudden extension, and is brought about by the impact of the undersurface of the patella upon the articular surface of the femoral condyles.

The diagnosis of the condition can be made only from x-ray films taken in a lateral view of the joint. The lesion appears at the upper peripheral surface of either condyle but is more common on the outer. The lateral view of an x-ray film taken of such a joint will show the articular capsule as a white line at the margin of the condyle which is elevated for a variable distance from the periphery. Associated with this finding there is usually present a variable degree of effusion into the joint and a thickening of the infrapatellar pad of fat. The pathological interpretation of this condition is based upon the objective findings, the clinical history, the mechanism of the injury and the x-ray evidence.

## ANATOMICAL CONSIDERATION

Cowdry<sup>1</sup> states that the articular capsule fits over the cartilage coated ends of the bones like a segment of pliable rubber hose equipped with well developed retaining fibers (collagenic) to prevent undue stretching. Meyer<sup>5</sup> maintains that a superficial fibroid layer (of hyaline articular carti-

lage) is found on the surface of articular cartilage. Whether this structure is a superficial fibroid layer of hyaline cartilage or is articular capsule, makes little difference so far as the findings are concerned in this particular pathological process. A thin, fibrous structure, however, is present which covers the ends of the articular cartilage. It is this tissue which is disturbed and shows changes in the x-ray film of injured knee joints.

## PATHOLOGY AND PATHOGENESIS

As a result of a direct trauma to the anterior surface of the knee, such as a fall or blow or as a result of a sudden contraction of the quadriceps muscle in sudden hyperextension of the knee, the patella is forced against the femoral condyles. This impact presumably causes a rupture of some of the subchondral arterioles in the spongy bone-end which it covers. The blood or serum which is liberated is forced between the platelets of articular cartilage and finds its way to the undersurface of the articular capsule. The capsule, therefore, is stripped away from the articular cartilage and is seen in the x-ray as a white, thin line, which blends with the capsule still attached to the periphery of the cartilage. As a result of tension and pressure beneath the elevated articular capsule, the cartilage cells become edematous, lose some of their staining properties and become fragmented. Degeneration of the cartilage cells results from pressure and interference of nutrition. This is evident by dark fragmented areas in the articular cartilage beneath the capsule. In certain cases the cartilage border is broken and vacuolated areas appear in the subchondral zone forming defects in the cartilage. I am of the opinion that the so-called "traumatic arthritic" processes

begin from a pathological disturbance such as is described above. Since cartilage has no vascularity, it may be assumed that the serofibrinous exudate which takes place beneath the elevated articular capsule, arises from the subchondral zone. The changes which are found in traumatic knee joints at operation, where defects of the articular surface are noted, may be traced to a disturbance such as has been described.

Axhausen<sup>2</sup> assumed that as a result of impaction from opposing articular surfaces, the blood vessels to the part are damaged, leading to necrosis of the area supplied by the damaged vessels. This undoubtedly is true in a large number of injuries occurring to the knee joint in which there may appear no early demonstrative changes. Both Phemister<sup>3</sup> and Axhausen refer to such a necrotic change which does not manifest itself immediately after injury and is presumably preceded by a stage of edema and pressure necrosis. It is this edematous process which is demonstrable, affecting the subchondral bone and giving rise to pericapsular stripping. Phemister states that a zone of absorption results and gradually causes separation and eventual extrusion of the dead portion into the joint. I do not believe, however, that separation occurs of necessity in all cases of injuries to the knee joint cartilage where absorption has resulted. If the reverse were true, a large number of knee joints with displaced cartilaginous fragments would be observed.

Chaklin,<sup>4</sup> in discussing injuries to the undersurface of the patella and of the femoral condyle, states that on the second day after injury, operation disclosed a defect in the cartilage of the patella. In four cases such changes were noted, presumably defects in the cartilage of the femoral condyle. Microscopically, in the early stages the only change that may be noted is edema of the cartilage cells and loss in staining properties. In Chaklin's series of thirty-eight operative cases, the early roentgenographic examination did not give positive results at first, but later by com-

paring the roentgenographic evidences with the operative findings and by microscopic examination of sections removed at operation they were able to establish changes which were not confirmatory in the early roentgenograms. It is my belief that if we were to study the roentgenograms of early traumatic knee joints and look for breaks in the continuity of the periphery of the articular cartilage and for abnormal shadows in the subchondral zone and compare them with the normal knee joint roentgenogram we would be able to demonstrate early defects.

#### ROENTGENOLOGICAL FINDINGS

Since x-ray films disclose shadows only, and these may be superimposed, it is advisable to take several films from different angles of the joint in the lateral position. Because the diagnosis of articular capsule stripping is dependent upon the x-ray evidence alone, it is essential, to study the film carefully for any break in continuity of the articular cartilage surface, and for any fragmentation and irregularity of the subchondral bone. The area which is most commonly involved is the upper one-third of the femoral condyle in the region of the patellar surface. The articular cartilage may be slightly uneven, suggesting the presence of fragmentation and degeneration. Associated with this finding are dense shadows in the infrapatellar space indicating hyperplasia of the synovial membrane and pad of fat. Dark vacuoles in this region may be due to the presence of a serous exudate in the joint. The same characteristic mottling and increased density may be present in the suprapatellar pouch.

Since in inflammatory reactions of the knee joint synovial membrane panus forms and spreads over the articular cartilage, any break in the surface will cause adhesion of the exudate to the articular cartilage surface. What eventually follows is an undermining of the cartilage cells with a resulting degeneration and ulceration. In the presence of inflammation, the cartilage

cells lose their elasticity, are spread apart and fissures and clefts form. These clefts may extend to the spongy bone upon which the cartilage cells rest. In time there follows a process such as is seen in chronic arthritis, namely, degeneration and proliferation of bone.

#### SYMPTOMS

A carefully taken history with a detailed analysis of the mechanism of the injury is very important. The patient usually states that he had received a direct blow to the outer side of the knee joint or that the knee was twisted in falling, or that in the attempt at sudden extension pain and discomfort were felt. The injury is not severe enough to produce a fracture nor is the twist of the knee joint similar in its mechanism to that which produces a displaced semilunar cartilage. There is, however, the history of a blow or a twist which brings about an impact of the undersurface of the patella to the articular cartilage of the femur. The pain in the knee joint is, as a rule, not very severe and is not definitely localized but may be referred to the region below the patella or to the outer side of the joint. The pain may be described as "an uneasy feeling in the joint" or "a dull, aching pain." It is seldom sharp and penetrating and there is no locking. The swelling as a rule is not very great. A puffiness is present below the patella and this, as compared with the opposite knee, is quite definite. With the knee fully extended this swelling becomes more apparent and fluctuation can often be demonstrated.

While there is no instability of the joint, there is, however, a limitation to full extension of the knee and pain can be elicited on motion.

#### DIAGNOSIS

The diagnosis of chondropathy and stripping of the articular capsule of the knee joint can be made early from the history and the nature and mechanism of the trauma, from the symptoms as described above and from a carefully studied

lateral roentgenogram. The condition must be differentiated from all internal derangements of the knee joint, especially from displacements and tears of the semilunar cartilages, from strangulation of villus tags and from acute exudative synovitis.

#### TREATMENT

Treatment consists in rest of the knee joint and the avoidance of weight-bearing. The latter is important because pressure and friction of the articular surfaces cause exudation and panus formation, hyperplasia of the synovial membrane and eventual softening of the articular cartilage. The knee, therefore, should either be placed in a plaster cast or a calliper brace worn for a period of about six to eight weeks. Physiotherapy, such as diathermy in conjunction with light massage should be instituted. Repeated x-ray examination should be made to determine the subsidence of the condition. However, if the pain persists, and if restriction to motion develops, when effusion continues and when the x-ray shows further destruction of articular cartilage and thickening of the synovial membrane and fat pad, operation is indicated. The procedure will depend upon the findings within the joint at the time of the arthrotomy. The defect on the articular surface should be removed, and this is often supplemented by synvectomy. If a loose and torn semilunar cartilage is found, it should be removed.

#### CASE REPORTS

CASE 1. (Fig. 1.) A young, athletic man of twenty-five stated that he sustained an injury to his right knee about three weeks before presenting himself for examination. He was lifting heavy boxes and one of these fell against his right knee, striking it on its outer side. There was no immediate disability and the pain did not prevent him from continuing his work. That night the knee swelled up and he could not fully bend it. He walked with a limp. On examination it was found that the knee joint was slightly distended with fluid. There was a slight bulging on the outer side of the knee and a slight puffiness above the patella. There was

tenderness on the outer side of the knee joint immediately below and to the outer side of the patella, and there was also a distinct limitation to full extension of the joint.



FIG. 1. Case I. White line along condylar surface with dark area beneath indicates capsular stripping with cartilage degeneration.

He brought x-ray films with him that were taken twelve days after the injury. The roent-



FIG. 3. Case III. Elevation and stripping of peri-articular capsule with degeneration of the subchondral zone.

genologist reported negative findings. However, on a close examination and study, it was found that there was an elevation of the articular

capsule involving almost the entire upper one-half of the condyle of the femur. The line was separated from the articular cartilage border and underneath this was a dark area slightly



FIG. 2. Case II. Elevation of capsule and degeneration of the articular cartilage.

wider above than below. There was a slight amount of fragmentation of the subchondral bone. The undersurface of the patella was sharply outlined with an area of rarification or rather decalcification of its entire lower margin. In the infrapatellar space, shadows and vacuolations were present indicating an edema and hyperplasia of the synovial membrane and pad of fat. The diagnosis in the case was pericapsular elevation and degeneration of articular cartilage associated with hyperplastic synovitis.

The limb was placed in a plaster cast from the ankle to the groin. The heel on the opposite shoe was elevated about half an inch and he was instructed to use crutches to avoid weight-bearing. The cast was removed after a period of six weeks, at which time physiotherapy was instituted. At the end of three months there was complete resolution of the condition and at this time, three years later, the patient is entirely recovered and has had no recurrence of symptoms.

CASE II. A young woman, aged twenty-three, stated that on November 18, 1938, she was hanging on to a strap in a street car. The car stopped suddenly and threw her forward. She twisted her left knee. The pain was not very severe and she was able to go home. That night she experienced "considerable discomfort" in the knee joint. She was awakened

several times during the night on account of distress in the joint. The following day she saw a doctor, who x-rayed the knee and told her that there were negative findings. The knee

able pain on the inner side of the knee below the lower border of the patella. He could not fully extend or flex the knee joint and walked with a distinct limp. On examination, there was con-



FIG. 4. Case iv. Capsular elevation and cartilaginous degeneration in the subpatellar region.

FIG. 5. Case v. Capsular stripping with degeneration of the articular cartilage on femoral condyle.

continued to trouble her and she was referred to me for consultation on April 22, 1939.

On examination it was found that she had pain on the inner side of her knee below and to the side of the patella. There was a slight amount of effusion in the joint and there was limitation to full extension. The x-ray (Fig. 2) revealed the following: In the lateral view of the joint there was an elevation and an unevenness of the upper margin of the articular capsule of the femoral condyle. There was an area of rarification of the articular cartilage evidenced by a dark, cup-shaped area. The articular cartilage was fragmented. There was also a thickening of the synovial membrane in the infrapatellar space. The diagnosis of this case was the same as the first, namely, elevation of the articular capsule and chondropathy. She was advised to wear a modified Thomas brace to avoid weight-bearing.

**CASE III.** A man, aged fifty, stated that on June 19, 1941, he stumbled and fell, striking his left knee against a sound-track in a movie studio. He experienced considerable pain, discomfort and disability in the knee joint and was assisted to the first aid station. On examination, it was found that he had a slight abrasion on the top of the knee, redness and some swelling. A rubber elastic bandage was applied. On the following day he experienced consider-

able effusion in the joint and there was marked tenderness on pressing the patella downward.

An x-ray was taken and it showed the following: elevation of the upper half of the articular cartilage of the outer condyle of the femur with areas of fragmentation of the cartilage, dark vacuolated areas in the infrapatellar space and thickening of the synovial membrane of the joint. The patient had never had trouble with his knee nor previous injury to the joint.

The manner in which this trauma occurred is characteristic. The patella was violently forced against the condyle of the femur, producing an injury to the synovial membrane of the joint and edema and exudation into the cartilage-covered condyle. The knee was immobilized and he was instructed to avoid weight bearing. He received diathermy treatment and light massage. On September 4, or ten weeks later, the x-rays showed a clearing up of the changes. There still remained, however, a slight tenderness to pressure about the patella.

**CASE IV.** A woman, aged thirty-five, slipped and fell about four years ago, striking against a piece of furniture. When she picked herself up she experienced severe pain and could not bend the left knee and limped to her bed. Soon afterward the knee became swollen and it was difficult for her to walk. The pain and discom-

fort subsided after a time, and she was able to get around without much difficulty; there remained, however, an "uneasy feeling" in the knee joint with occasional boring pain and swelling. On examination it was found that there was a limitation to full extension of the joint and considerable pain on full flexion. There was a slight amount of effusion in the joint and tenderness on pressure on the inner side below and the side of the patella. There had been no locking at any time. The x-ray (Fig. 4) revealed a slight articular capsular elevation over the condyle immediately behind the patella. There was a dark area beneath the capsular elevation, with slight fragmentation indicating an involvement of the articular cartilage. The patient was instructed to refrain from weight-bearing, and physiotherapy was carried out for several weeks. She made considerable improvement. However, the arthropathy was of long standing and the changes in the joint were of a permanent character that would not respond to palliative means.

CASE V. (Fig. 5.) A woman, aged forty-five, stated that about two years ago she fell and twisted her right knee joint. She was not incapacitated and continued to walk although she experienced considerable pain in her knee. When she arrived home she found the knee swollen and tender and she could not bend it freely. The pain, discomfort and swelling continued for about ten days. The swelling soon subsided but an unsteadiness in the knee remained.

Our examination showed a slight amount of swelling to the inner side of the patella. There was some limitation to full extension of the joint and pain on extreme flexion. There was no lateral or anteroposterior instability. Pressure over the patella gave rise to some pain. The x-ray showed a capsular stripping with

degeneration of the subchondral zone. Associated with this x-ray finding there was unquestionably present a chronic hyperplastic synovitis.

#### SUMMARY AND CONCLUSION

Although five illustrated cases are here reported, the author has in the past four years treated about fifty patients with this type of derangement of the knee. A search of the literature failed to show the report of similar cases, aside from those which appeared by Chaklin. Most of the early cases of 'pericapsular stripping' are diagnosed as "traumatic arthritis" with presumably no demonstrable x-ray findings. This type of arthropathy can be demonstrated only by means of the roentgenogram taken in the lateral view of the joint. It may be assumed that this pathological derangement is a forerunner of what eventually becomes a chronic degenerative or hypertrophic arthritis. Proper immobilization and the avoidance of weight-bearing will prevent further destruction of the joint surface and will hasten absorption of the exudate.

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# TENDINITIS OSSIFICANS TRAUMATICA\*

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CALCIFICATION in and about tendons, myositis ossificans and ossification in tendons have all been included under the general heading of "tendinitis ossificans traumatica." However, these conditions are essentially different and should be discussed separately as illustrations of calcification or ossification.

Calcification is found in tissues whose metabolism is normally low. Campbell and others state that calcification is a process of death and requires necrotic tissue for its deposition. Even in such relatively avascular tissue such as tendons, ligaments, cartilages, etc., the fibrosis which follows trauma or infection results in still further reduction in the metabolic rate and aids in the deposition of calcium.

Ossification, on the other hand, occurs in tissue whose metabolism is high. In consequence, it is seen characteristically in and about highly vascular tissue such as muscle or structures close to the periosteum. This process may present itself in several forms such as spur formation, ossification of subperiosteal hematoma and myositis ossificans. Some authors have included in this category the formation of sesamoids. However, these are normal developments, are usually symmetrical and appear early in life.

These two processes are distinct and occur under different circumstances but with increased metabolism and an excess of calcium, areas of calcification may ossify and form new bone. Pathological calcareous deposits in any region of the body may therefore change into pathological ossific deposits if the blood supply should become adequate. In Paget's disease, fractures occur in the early stage when the bone

shows granular calcification. They do not occur in the later stage when increased vascularity plus calcification has progressed to re-ossification as demonstrated by the formation of new bone.

The appearance of ossification in tissue attached to or close to periosteum is readily comprehensible as a manifestation of the osteogenic properties of periosteum. When the periosteum is elevated, bone develops within the new limits of the periosteum, and it is this process which explains the formation of spurs and subperiosteal hematomas due to trauma, scurvy, etc. When spurs occur at the insertion of muscles, they are likewise due to the pull on the periosteum and the production of bone within this space. This process is not the primary concern of the present report.

Myositis ossificans, as its name implies, develops within the muscle. This may appear as the result of a single injury but more often is caused by chronic multiple traumas. It may develop from a periosteal injury or from the interstitial fibrous tissue in muscle. From the roentgenological point of view it presents the appearance of a "typically laminated structure of the bone deposits and the so-called 'dotted veil' appearance." Because of its location it can readily be differentiated from the ossification which occurs in tendons.

While myositis ossificans and tendinitis ossificans may occasionally present difficulties from a roentgenological point of view, the x-ray differentiation between calcification of ossification in a tendon is almost impossible.

There have been a number of reports labelled "Tendinitis Ossificans Trau-

\* From the Service of Dr. E. D. Oppenheimer, Beth Israel Hospital and Dr. H. Milch, Hospital for Joint Diseases, New York.

matica" but some of these are cases of calcification. In some, the diagnosis was made only on the roentgen films. However,



FIG. 1. Case I. Shows two calcific masses which appeared to be in the tendo-achillis.

one cannot readily differentiate these two conditions on the basis of roentgenography alone, as in both instances a shadow may be cast. In fact, the roentgenologists use the terms ossification and calcification interchangeably. According to Dr. Jaffe, "The differential diagnosis can be made only on tissue examination. Calcification is distinct from ossification only by the pathological process where calcareous material is so distributed as not to make bone; in ossification actual bone is organized."

Tendinitis ossificans traumatica is a relatively rare occurrence. It is usually produced by a single trauma. Although the tendon may be somewhat compressed, there will be no evidence of necrosis. New bone with a cortex and medulla is formed within the tendon. This new bone formation is the result of increased metabolism plus an excess of calcium brought to the part by the hyperemia of the trauma. This ossification has no connection to the bone, or the periosteum, or the muscle and, therefore, is an entity by itself and is not to be confused with calcification or myositis.

The following two cases of proved tendinitis ossificans traumatica are herein presented:

#### CASE REPORTS

CASE I. J. S., twenty-four years old, was in a motorcycle accident March, 1934, at which



FIG. 2. Shows the exterior and interior of the mass shown in Figure 1.

time his right heel was lacerated. The wound became infected and healed only after considerable trouble. When seen in August, 1935, the patient complained of pain in the lower part of the leg but walked without any limp. There were several scars about the heel and the lower third of the right tendo-achilles; there was no limitation of motion at the foot or ankle. The x-ray (Fig. 1) shows two calcific masses which seem to be in the achilles tendon. At operation, this tendon was exposed but appeared to be normal. Upon probing with a needle the mass was found within the substance of this tendon. This mass (Fig. 2) was removed and the wound closed. Since the operation the patient has been free of any symptoms. On section, two ossifying nuclei containing spongy bone with some fatty marrow were found.

CASE II. H. H., fourteen years old, was kicked in the right leg August, 1939, eight weeks prior to admission. This kick was followed by pain near the site of the injury, accompanied by swelling without ecchymosis. This swelling remained constant in size, however, the discomfort diminished. His chief complaint was pain in the calf of the leg upon walking. The patient lost fifteen pounds in weight during the eight weeks before admission.

Physical examination revealed the patient to be fairly well nourished despite his loss of weight. He limped holding his right knee flexed and the foot in marked equinus. Motion at this knee was normal; dorsiflexion of this ankle was possible only through a range of about 10 degrees. There was a mass in the middle third of the right leg; this was firm,

slightly tender and movable; it was not attached to the overlying skin or to the underlying bone. Roentgenograms of this leg (Fig. 3)

relatively soft, gelatinous gray tissue. *Microscopic:* At the periphery, at one end, practically normal tendinous tissue is situated. A rather



FIG. 3. Shows the mass in Case 11.

were reported as showing "an irregular lobulated calcified mass in the soft tissues of the lower part of the leg. The periosteum of the fibula shows exudative and productive changes. The tibia was normal." X-rays of the other leg, pelvis, femora and chest were negative. Blood calcium, phosphorous and phosphatase were all within the normal limits. The blood count showed a mild anemia. Urine examination and blood Wassermann were negative.

At operation, a hard bony mass was found attached to the anterolateral aspect of the upper third of the tendo-achilles. In this region, the tendon was thin but showed no evidence of inflammation nor connective tissue formation. The mass was readily removed without any bleeding. After skin closure, a circular plaster of paris bandage was applied keeping the foot in moderate equinus. Five weeks after the operation, the patient walked without any limp; there was no discomfort upon walking and no limitation of dorsiflexion.

The *pathological* report was as follows: Gross specimen (Fig. 4) is that of a bony mass 6.5 by 5.5 by 4 cm. The outer shell consists of rather dense bone about 1 cm. in greatest thickness. The central portion consists of

regular net work of normal appearing cancellous bone permeates the structure, corre-



FIG. 4. Shows the exterior and interior of the mass shown in Figure 3.

sponding to the gross aspect. Osteoplastic layers are very distinct. There is very little evidence of osteoclastic processes, with small

indistinct lacunae and very occasional giant cells. There is no cartilage, no osteoid substance, no hemorrhage, no pigment, no necrosis, no scars and no foci of calcification. Diagnosis: Bone formation in tendon (so-called tendinitis ossificans traumatica).

#### CONCLUSION

Two cases of tendinitis ossificans traumatica are presented with a differential

diagnosis of myositis ossificans, spur formation, calcification and tendinitis ossificans traumatica.

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WHEN reduction is not possible with open operation, the most useful function of the shoulder joint is obtained by resection of the head of the humerus.

From—"A Manual of the Treatment of Fractures" by John A. Caldwell (Charles C. Thomas).

# SPLenic TRANSPLANTS FOLLOWING TRAUMATIC RUPTURE OF SPLEEN AND SPLENECTOMY

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A SEARCH of the literature reveals that such extensive trauma to the normal spleen as to require splenectomy is moderately rare; to demonstrate the development of functional splenic tissue following such an injury and splenectomy is of sufficiently rare occurrence as to warrant the report of this case.

## CASE REPORT

On March 12, 1936, an eleven year old boy was brought to the hospital complaining of abdominal pain and shortness of breath. The boy's parents were both living and well, one sister had died of mastoiditis and meningitis, and another sister and a brother were living and in good health. The boy himself had had measles, chickenpox, whooping cough and pneumonia. His only surgical experience had been a tonsillectomy at the age of five.

About three hours before he was brought to the hospital, he had injured himself in a bicycle accident. Riding his bicycle at full speed, he collided with a parked automobile. The rubber grip of one handlebar struck him forcibly in the left upper quadrant. It was reported that the blow "knocked the breath" out of him. He was carried to his home. Some two hours following the accident, the patient complained of increasing abdominal pain, painful respiration and shortness of breath. His parents then took him to the hospital.

Physical examination was as follows: The patient was a well developed, well nourished white boy of eleven, in acute pain and having respiratory difficulty. The skin was pale and dry. The scalp and cranium showed no abnormality. The pupils were moderately dilated, equal in size and reacted to light. The ears, nose, teeth, gums, tongue, pharynx, thyroid and cervical lymph glands were all examined with negative findings. The heart was not enlarged, the rhythm was regular, there were no murmurs and the rate was seventy-two. The

lungs were clear to percussion and auscultation, but the patient had much pain in his left lower chest at each inspiration. No pleural friction rub was audible. The liver edge was not palpable, though there was moderate tenderness in this area. There was considerable abdominal distention, and a fluid wave could be demonstrated. There was tenderness in the costolumbar angle on each side. The spleen was not palpable. No masses were palpable. There was generalized abdominal tenderness and rigidity, both being most pronounced in the left upper quadrant. There were no palpable lymphnodes. The extremities showed no evidence of injury beyond abrasions. Rectal examination revealed no unusual tenderness nor any masses. The external genital organs were normal and there was no hernia.

Urinalysis showed 2 plus albumin, no sugar, no acetone, an occasional granular cast, a fair number of red blood cells, and a few white blood cells. Blood studies showed 3,900,000 red blood cells, with a hemoglobin of 75 per cent. The white blood cell count was 13,200; 83 per cent polymorphonuclear neutrophils, 11 per cent small lymphocytes, 4 per cent large lymphocytes, 1 per cent eosinophils and 1 per cent monocytes. The patient's blood was type IV.

From the history of severe injury and from the physical findings, it was thought the patient had a ruptured viscus with intra-abdominal hemorrhage. X-ray films were made of the chest and abdomen. Both diaphragm shadows were clear. There was no evidence of fluid in either side of the chest. The heart and aorta were within normal limits as to size, shape and position. There was no evidence of pulmonary tuberculosis or other infiltration or consolidation. A single film of the abdomen showed no abnormality except a generalized lack of detail. The roentgenologist's conclusions were that the chest was negative and that the lack of detail over the abdomen suggested the presence of fluid in the peritoneal cavity.

Approximately two hours after admission and five hours after the accident the patient was given a general anesthetic and his abdomen

in two places and microscopic evidence of hemorrhage in the body of the spleen near the points of rupture.

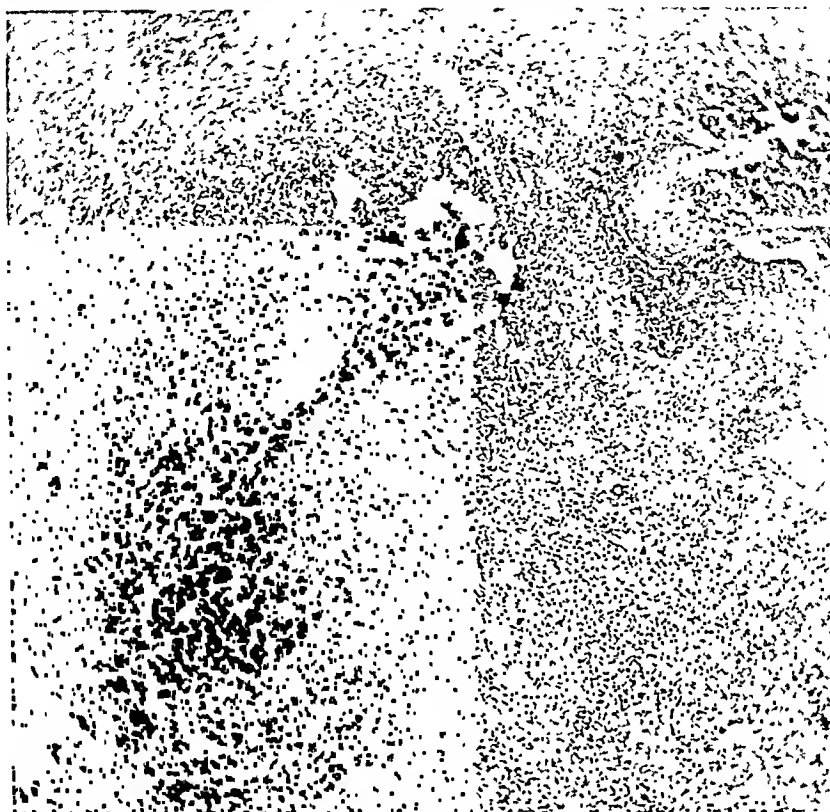


FIG. 1. Photomicrograph of a representative area of one of the sections taken from splenic transplant. A splenic artery can be seen in the edge of a splenic node or malpighian body, and the relationship of the node to the surrounding pulp tissue can be seen. On one edge of the section a fragment of trabecula can be distinguished. A few inflammatory cells and eosinophiles are scattered throughout the section. There is a large amount of blood pigment. Fairly large venous sinuses may be seen.

was opened. A one-inch incision was enlarged upward and downward to five inches and dark blood was encountered within the abdominal cavity. The spleen was found to be ruptured so that it was made up of two equal large pieces and a small piece. Seven or 800 cc. of free blood was present in the abdomen; this was removed by aspiration. The pedicle of the spleen was clamped and ligated and the three pieces were removed. Following closure of the wound, a transfusion of 575 cc. of whole blood was given by the direct method. The operation required forty-one minutes. The pulse rate had risen from 120 at the beginning of the operation to 132 at the finish. The patient was in moderate shock before receiving the blood transfusion.

The pathologist reported that the spleen was normal, except for rupture through the capsule

The patient enjoyed an uneventful convalescence and was discharged in good condition on his tenth day.

He led a normal, active boy's life and did not require medical attention again until May 17, 1938, when he suffered simple transverse fractures of the left radius and ulna, at the junction of their middle and lower thirds. These fractures healed satisfactorily, except that on July 20, 1938, he had the misfortune to re fracture his left radius at the site of the previous fracture, necessitating an additional period of immobilization.

Approximately two years ago, in the early part of 1940, he was operated upon by another surgeon at another hospital for chronic appendicitis. His doctor tells me that only a small incision was made, and that no attempt was

made to explore the previous site of the spleen or any area other than the cecum, appendix and terminal ileum. A chronically inflamed appendix was removed. No nodules were noted in the abdomen, though no special search was made for them.

In October, 1940, the patient was seen in the clinic complaining of cramping abdominal pain and discomfort in the left upper quadrant. He was told to use mineral oil, eat soft foods and to report monthly. He was further advised that, if he failed to improve under this treatment, it would be necessary to perform a laparotomy for relief of adhesions. He was subsequently seen on several occasions, still complaining of cramping pains, "pulling" in the left upper quadrant and a loss of eight pounds of weight.

On February 23, 1941, the patient entered the hospital for operation. He was then sixteen years old. Physical examination revealed no abnormalities except a functional mitral systolic murmur and slight tenderness in the left upper quadrant beneath the old operative scar. A urinalysis was normal. Blood Wassermann was negative. His blood counts showed 4,770,000 red cells and 14,000 white cells; hemoglobin was 90 per cent. There were 10 per cent staff cells, 70 per cent segmented neutrophils and 20 per cent lymphocytes. No pathological forms of red blood cells were seen in the stained smear.

On February 24, 1941, under ether anesthesia, the patient was operated upon. A high left rectus incision was made, excising the previous scar. There were many adhesions from the omentum to the anterior abdominal wall, from the omentum to the cecum, from the stomach to the anterior abdominal wall and from the liver to the anterior abdominal wall. These adhesions were all carefully separated. Attached to the omentum on both its surfaces were twenty or thirty brownish-red, soft, encapsulated nodules ranging from 1 to 2 cm. in diameter. No nodules were found attached to intestines, mesentery or peritoneum. The surface appearance and color resembled spleen. Two of these nodules were removed for microscopic study. No remnant of the spleen could be found at its former normal location.

The pathologist, Dr. May Owen, describes the biopsies as follows:

"The specimen submitted consists of two rounded, fairly firm, smooth, dark reddish-blue tumors. The larger tumor measures 2 by

1.5 by 1 cm. and the smaller 1.3 by 1 by .8 cm. Small tags of fat are attached to the capsules. The cut surfaces are dark reddish-brown.

"Microscopical sections show the capsules to be irregularly thickened. On the outer surface of the capsules there are tags of loose vascular fibrous tissue. The tumors show loose diffuse fibrous stroma with many varying sized blood spaces, a large percent of which are filled with blood. There are a few germ centers and an occasional Malpighian body. A few inflammatory cells and eosinophiles are scattered throughout the sections. The inflammatory cells are particularly noticeable in sections from the smaller biopsy. Sections from both tumors contain a large amount of blood pigment.

"Findings: Inflammatory small accessory spleens."

A photomicrograph made from a representative area of one of these sections shows a splenic artery in the edge of a splenic node or Malpighian body and shows the relationship of the node to the surrounding pulp tissue. On one edge of the section a fragment of trabecula may be distinguished.

Following operation, the patient did nicely and was able to go home on his tenth day. At an office visit two months following his operation, he stated that he had gained twenty pounds since operation, but that he still occasionally had some discomfort in his left upper quadrant, though never so severe as previously. Since his visit he has reported at intervals and has had gradually decreasing abdominal discomfort. Blood counts made February 26, 1942, showed 4,960,000 erythrocytes and 10,100 leukocytes; hemoglobin was 96 per cent. There were 3 per cent staff cells, 64 per cent segmented neutrophils, 23 per cent lymphocytes and 10 per cent monocytes.

In 1921, Eccles and Freer reported a case of ruptured spleen in a twenty-one year old man. The spleen was removed in its entirety. Ten years later, during the course of an operation for incisional hernia, an organ resembling a normal spleen in all outward appearances was found in the usual location of the spleen. No abdominal nodules were described. The authors considered this to be an enlarged splenic body, hypertrophied under the impetus given by the removal of the main splenic body.

Marine and Manley did the earliest successful work on autotransplantation of splenic tissue and concluded that survival and growth are the rule.

Silberberg, in 1935, demonstrated that hemopoietic organs have no marked resistance to transplantation, though survival is not as good as epithelial organs and cells or connective tissue. He concluded that autotransplants of spleen manifest positive growth and full regenerative ability.

Perla, in 1936, reported his work on regeneration of autoplasmic splenic transplants in mature albino rats. He concluded that there was complete regeneration of large transplants in from twelve to twenty-one days, and that the morphological structure of adult spleen tissue is present in the transplant, with well developed capsule and trabeculas. His studies indicated to him that the reticular cell of the adult spleen retains its potentiality for differentiation and may be the precursor of the structural elements of the spleen.

In 1939, Buchbinder and Lipkoff report in detail the case of a twenty-eight year old Puerto Rican woman who had suffered rupture of her spleen in 1919 as the result of being struck by an automobile. At operation many purple-red nodules were found on the parietal peritoneum, greater omentum, ileum, ascending colon and sigmoid. The histologic characteristics were those of splenic nodules. The authors concluded that these nodules arose from autotransplantation of splenic tissue throughout the abdominal cavity following trauma of the spleen. They pointed out the possibility of confusing such nodules of splenic tissue with endometrial implants. They offered the term "splenosis" to describe this condition. The authors were able to collect from the literature only nine other cases which they considered paralleled their own. These were reported by Albrecht in 1896, Schilling in 1907, Von Kuttner in 1910, Foltin in 1911, Von Steubenraush in 1912, Oltman in 1919, Lee in 1923, Kupperman in 1936, and Shaw and Shafi in 1937.

In 1941, Rousselot and Illyne discussed traumatic rupture of the spleen, stressing the diagnosis, treatment and sequelae. Among other aspects, they studied the blood pictures of seventeen patients who had had splenectomy for traumatic rupture. They found that, although several patients showed anemia for a short while following operation, this anemia could be explained on the basis of hemorrhage. There was no persistent anemia. They did find persistent leukocytosis, thrombocytosis and relative lymphocytosis. Their findings of no anemia, but persistent leukocytosis and relative lymphocytosis are in accordance with the blood findings of the case I am reporting today. Of the seventeen cases reported by these authors, one was found at autopsy one and one-half years later to have many implants of splenic tissue scattered over the left lobe of the liver. The left dome of the diaphragm, the stomach, lesser omentum, transverse colon, right kidney, pelvis, anterior wall of the rectum and posterior wall of the bladder. This same case was described by Jarcho and Anderson, in 1939, and in addition another similar case was reported. Jarcho and Anderson were interested chiefly in the source from which these splenic nodules came. Several hypotheses propounded by other authors were examined and discarded. Among these were the ideas that: (1) the splenic nodules existed prior to the injury to the spleen, (2) that the nodules are formed from pre-existing lymphoid tissue or splenic anlage, and (3) that the nodules are formed by the peritoneum, perhaps under the stimulus of splenectomy. In support of their own theory of transplantation or "seedling" of the peritoneum from the pulp of the traumatized spleen, they observe that the occurrence of widely disseminated splenic nodules in any considerable number has never been reported after splenectomy in cases of nontraumatic disease of the spleen. This suggests that the determining factor is not splenectomy but trauma.

This theory of transplantation of particles of splenic pulp is in accordance with my own view and is offered as explanation of the presence of nodules of splenic tissue in the omentum of the case I have reported.

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OBSTRUCTION of the small bowel can usually be readily distinguished by the occurrence of frequent and copious vomiting and by the distended loops of small intestine seen in the skiagram. One of the most difficult differentiations to make, and one which occasionally cannot be made without recourse to operation, is that of distinguishing a spastic obstruction of the colon from a mechanical block.

From—"Intestinal Obstructions" by Owen H. Wangensteen (Charles C. Thomas).

# INTRA-ABDOMINAL HEMORRHAGE DUE TO SPONTANEOUS RUPTURE OF A VEIN ON A FIBROID UTERUS

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THE rupture of a vein on a fibromyoma of the uterus with intra-abdominal hemorrhage, is a rare finding, and only forty-eight similar cases have been reported.

## CASE REPORT

L. B., colored, aged forty, was brought into the hospital by ambulance. Her chief complaints were (1) sharp pains in the abdomen, (2) swelling of the abdomen and (3) weakness. The onset of the above was sudden and had occurred about twenty hours prior to admission. The only relevant fact in the past history, was that one year ago, she had refused operation for an abdominal tumor at a municipal hospital. She had had normal menses until four months before admission; since then she had been amenorrheic. For the last few days there had been slight vaginal spotting. She had had no bowel movement for two days.

She was pale, had a cold clammy skin and appeared very weak. Her pulse was thready, of poor quality; the rate varied between 96 and 120. Her blood pressure was 90/60. The temperature was 101°F. The hemoglobin was 42 per cent; red blood cells 3,280,000; white blood cells 4,200.

The abdomen was markedly distended and tender throughout. A nodular, stony-hard, tender mass filled the entire abdominal cavity, reaching to the xiphoid. A fluid wave was also present.

The pelvic examination showed the cervix to be high, and the uterus merged into the abdominal mass. The fornices were clear, and not tender. The aspiration of the fluid in the abdominal cavity revealed the presence of blood. The preoperative diagnosis was a large fibromyomatous uterus, associated with intra-abdominal hemorrhage from an undetermined source.

Preoperatively the patient received an intravenous infusion of 5 per cent glucose. The operation was started under local anesthesia. The latter, however, was unsatisfactory, and she was given a general anesthesia of gas, oxygen and ether.

Upon opening the peritoneal cavity, almost two liters of bloody fluid escaped, in part old blood. (This accounts for the low white count.) A huge fibroid uterus was seen and easily delivered through the wound. (Fig. 1.) On the posterior aspect of the proximal portion of the tumor, there was a defect in a superficial vein. Careful search failed to reveal any other source of bleeding.

A supracervical hysterectomy and right salpingo-oophorectomy were done, the stumps peritonealized, the remaining fluid evacuated by suction and the abdominal wall closed.

The infusion of 5 per cent glucose which had been given throughout the operation was continued and supplemented by a transfusion of 500 cc. of blood.

Recovery was uneventful except for a paracervical exudate. The wound healed by primary union and she was discharged on the twenty-seventh postoperative day.

The pathological report, made by Dr. Arthur M. Ginzler, is as follows:

"Specimen is a supracervically amputated uterus weighing approximately 3200 Gm. It contains numerous subserous, intramural, and submucous fibromyomata varying in size from 1 cm. in diameter to a large subserous fibroid measuring approximately 16 cm. in diameter. The serosal aspect of this large fibromyoma exhibits irregular plaque-like areas of grayish-white thickening. Close by, the scrota presents a thin-walled channel with an irregular tear. (Fig. 2.) The fibromyomata on section shows degenerative changes and extensive areas of calcification.

"The endometrium is smooth, thin and pale.

"A tube and ovary, grossly normal, are attached to the uterus.

"Pathological Diagnosis: Multiple fibromyomata of uterus showing degenerative changes and hemorrhage."



FIG. 1. Gross specimen of uterus and fibromyomas, weight 3,200 Gm.

"Histological: Sections show multiple fibromyomata of typical structure. There are extensive degenerative changes and areas of calcification. One fibromyoma, as grossly described, presents on its serosal aspect, a plaque-like layer of hyaline fibrosis containing many dilated, thin-walled vessels and focal areas of chronic inflammation. Some sections show extravasation of red blood cells about these vessels, and, in one section, there is what appears to be a tear tract, apparently produced by tissue degeneration, containing blood and fibrin.



FIG. 2. Photograph of ruptured vein. Two straws have been inserted to indicate veins and location of rupture.

The area of irregular plaque-like thickening described by Dr. Ginzler was on the posterior surface of the large fibroid, in close contact with the spinal column. Because of the presence of old blood in the abdomen, and the acute onset, twenty hours prior to admission, one may infer that there had been bleeding from the ruptured vein. The precipitating factor can not be accounted for in the history obtained.

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# TRAUMATIC RUPTURE OF THE KIDNEY\*

## CASE REPORT

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I N presenting this case I will begin with the statement of the patient:

"I was operating engine on a dredge at Vernon View, twelve miles from Savannah, and

his back. Dr. Graham saw him every two hours, and at 8:30 P.M., as the patient had not voided, he was catheterized and almost pure blood obtained. The author was then called in consultation.



FIG. 1. Illustration of ruptured kidney.

had started the 60-horse power caterpillar engine. I was squatting down closing the relief valve, when the engine exploded at the base, blowing off the hand-hold plates. A piece of plate about the size of my two hands struck me in the side and chest. It did not knock me off my feet, but at first it seemed that every breath would be my last, and I realized that the force of the explosion had hit me a stunning blow in my stomach. The whole thing caught fire, and I ran back to the rear deck and lay down, until the crew could put the fire out. Then I got into a batcau, and the men rowed me ashore. Upon reaching shore I walked to Mr. Floyd's car, about 25 yards, and without help got in, and stretched out on the back seat. I was in great pain."

The patient was carried to Warren A. Candler Hospital. He was in shock, and Dr. R. E. Graham instituted shock treatment immediately. The patient complained of great pain in his lower left chest, and of mild pain in

I found a man, forty-four years of age, of slight build. The patient had a temperature of 96°F., pulse 80, and respiration 20. His blood pressure was 110/70. He complained of pain in the left side of the thorax with every inhalation. His color was fair, not that deathly pallor so pronounced in prolonged and profound shock. The abdomen was fairly rigid in the upper left quadrant. There was a slight laceration two inches long over the eleventh rib, where he was struck by the steel plate. I helped the patient to sit up, and when I pressed with my closed fist over the costovertebral angle, he flinched and cried out with pain. I was sure he had a ruptured kidney, and ordered him to the operating room. This was at 10:00 P.M.; the patient had entered the hospital at 11:00 A.M.

The patient was given  $\frac{1}{6}$  gr. of morphia, and  $\frac{1}{150}$  gr. of atropine, and placed in the usual kidney position. Straight ether anesthesia was used throughout. The usual lumbar incision was made, and as soon as I reached the kidney space a 10 per cent intravenous glucose solution

\* Presented before the Georgia Medical Society, Savannah, Georgia, February 24, 1942.

was started. I encountered severe oozing at once, and breaking through the clots, put my finger into the large rent in the kidney. The tissues surrounding the kidney and the capsule were severely macerated, but by taking hold of the torn capsule in several places with Kelly clamps, I was able to lift the upper pole into the incision, and apply Kelly clamps to individual spurters. The upper half of the kidney, being free from the wound and attached to the lower half only by a bit of tissue the size of my little finger, was cut away. This made the freeing of the lower half of the kidney much easier, and I could then get my index and middle fingers under the blood vessels and pelvis, which I tied off with chromic catgut. I did not apply a kidney clamp to the pelvis, for it was impossible to determine how much damage had been done to the walls of the vessels, which in the left kidney are only about half as long as in the right. The lower half was then freed and cut away and a Penrose drain

inserted. Five hundred cc. of whole blood were given after the operation and the patient made an uneventful recovery.

J. Bentley Squier reports that "in 1000 cases of traumatic injury passing through the clinic, only one involved the kidney; and in all surgical diseases of the kidney, only eight per cent are due to injury."\*

#### CONCLUSION

This case is of interest (1) because the explosive force from in front literally shattered the kidney, tearing it almost in two from end to end as well as across the middle, and caused no injury to other viscera, and (2) this patient missed death from internal hemorrhage by a very small margin.

\* Cabot's Modern Urology. Vol. 2, p. 424.



# NEPHROPEXY

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NEPHROPEXY is a subject characterized by a controversial and voluminous literature and is at present recovering from an era of ridicule into which it was plunged by over zealous and avaricious operators. It is the purpose of this dissertation to emphasize the salient diagnostic points in nephroptosis and to present the merits of a method of nephropexy.

It is significant that renal ptosis is more often asymptomatic than symptomatic. Hence, nephroptosis *per se* is not a clinical entity, but becomes so only when it incites ureteral or pelvic obstruction. Unless each of the several diagnostic points are pre-operatively demonstrated in every instance of nephroptosis the patient, after operation, can and often will accuse the doctor or having been too anxious to "use the knife."

## DIAGNOSIS

1. The patient must subjectively present the fact that bed rest completely alleviates the pain which can be reproduced by getting up.

2. Some degree of hydronephrosis or pyelectasis must be visualized by pyelography.

3. The emptying of the kidney must be delayed (normal emptying time is seven minutes or less).

4. Renal distention by retrograde pyelography must reproduce specifically the patient's pain.

5. Ptosis of the kidney must be demonstrated by pyelography and the tortuosity of the ureter must be visualized so as to eliminate the possibility of renal ectopia. After all the above points have been clearly demonstrated individually without exception, suspension of the kidney may be

advocated with assurance of affecting permanent symptomatic relief.

## OPERATIVE PROCEDURE

Through a Bergman-Israel incision the kidney is exposed and cleaned of its fatty capsule. The twelfth rib is isolated extra-periosteally, anterior to the great back muscles, by incising the muscles along its external border.

Two incisions are made in the renal capsule on its posterior aspect approximately 1.5 cm. in length and oblique to the long axis of the kidney; one near the upper pole and the other near the pelvis. The intervening capsule is tunnelled with a groove director.

A Kocher clamp is passed in a postero-medial direction through the capsular tunnel and the kidney threaded on the rib by clamping the tip of the latter with the clamp and sliding the kidney in position. The points of incision and location of the kidney, when anchored on the rib, can best be visualized by referring to Figure 1.

After the kidney is in place the tip of the rib is broken and sutured to the periosteum of the eleventh rib as shown. The fatty renal capsule is replaced with an additional obliterating suture at the lower renal pole. The wound is closed without a drain.

## CASE REPORTS AND DISCUSSION

This method of nephropexy has been used in four cases (one male and three females) with astonishing success. It is in keeping with a far more comfortable post-operative course since in each instance the patient was allowed to sit up in bed after the fourth postoperative day, out of bed

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before the ninth day and home within twelve days. This rapid and comfortable postoperative period is a far cry from the

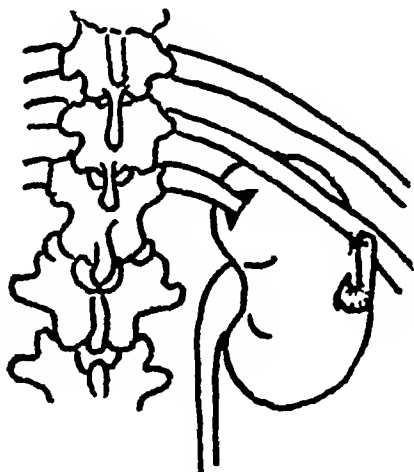


FIG. 1. Costal suspension of kidney (posterior view).

usual prolonged period of the Trendelenburg position advocated following other methods of nephropexy. It was because of this long and disagreeable period following nephropexy that another method was sought which would affect a stable renal fixation with a minimum of discomfort and hospitalization.

Two cases have been followed by re-

peated pyelograms for more than two years and the kidney found in the normal position. Both individuals have been working since the eighth week following operation, one being a laborer. The two remaining cases one and one-half years following suspension reveal the kidney in good position. None of the patients has suffered any recurrence of symptoms and each is in excellent health.

In so far as can be determined this series of four cases is the only one described since Stanischeff reported his eleven original cases in 1934. With the success experienced and the relative simplicity of the procedure it would seem that this operation is worthy of widespread popularity.

#### SUMMARY

1. The essential diagnostic points of symptomatic nephroptosis are reviewed.
2. A method of nephropexy is described.
3. Four cases are reported to add to the series of eleven originally mentioned by Stanischeff.

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# MULTIPLE ATTACKS OF ACUTE INTUSSUSCEPTION\*

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MORE than one attack of acute intussusception requiring surgical relief is certainly unusual, but three attacks in less than one year, with recovery is surely enough of a surgical curiosity to warrant a case report.

Todyo, in 1938, reported in the *Annals of Surgery*, a review of 342 patients with acute intestinal obstruction, and intussusception was found to be the cause in 45 per cent. In more than half of these cases, the cecum was found to be mobile.

Since such a high percentage of the cases with intussusception are associated with a mobile cecum, it does seem logical to assume that if the cecum is fixed at the time of operation, the chance of recurrence will be definitely decreased. It has been suggested that by doing an appendicostomy, the cecum can be fixed in a very quick and simple manner; but unfortunately, the appendix may stretch and simply become a fibrous band, which is not sufficiently strong to maintain the fixation. The procedure that I have adopted, consists in incising the peritoneum of the lateral abdominal wall adjacent to the cecum, loosening it in such a manner that a pocket is formed, and then suturing the cecum in this pocket for a distance of six to eight inches. Sufficient adhesions will of necessity form that will definitely anchor the cecum, so that it will be permanently fixed. It seems logical to assume that the peristaltic waves can not be as active in this area with the cecum fixed, and therefore this procedure should prevent the recurrence of any further intussusception in this segment of the bowel. Certainly in the case to be reported, the cecum was found to be very mobile at all three operations for the relief of the intussusception, and after the

cecum was fixed, the child had no further recurrences.

## CASE REPORT

On June 7, 1937, J. D., female, five and one-half years of age, was referred by Dr. Maurice Lonsway with a diagnosis of acute intussusception. She complained of severe pain in the right lower quadrant of the abdomen which was paroxysmal in character, and was associated with nausea and vomiting. Her mother noted that whenever the child strained while vomiting, she involuntarily passed a small amount of bloody fluid from her rectum. On examination, her abdomen was quite tender and there was definite rigidity over the right lower portion, and a mass was easily felt in the region of the cecum. Examination of the blood showed leucocytosis of 20,000.

At operation free fluid was found in the abdomen and eighteen inches of ileum were invaginated into the cecum. The intussusception was reduced with some difficulty. The appendix was subacutely inflamed and it was deemed advisable to remove it. About six inches of the ileum was then sutured to the medial side of the cecum and the ascending colon, with the hope that this would prevent any recurrence of the intussusception. The child made a satisfactory recovery and was discharged on June 17, 1937.

On September 2, 1937, the child awakened her mother, crying with pain in her abdomen. She was again admitted to St. Luke's Hospital with a diagnosis of acute intussusception. The white blood count was 14,600 with 12 per cent stabs and examination revealed a mass that was easily felt in the right lower part of the abdomen.

At operation the old scar was excised and the abdomen was opened without difficulty as there were practically no adhesions noted. There was quite a large intussusception and the cecum and ascending colon were entirely filled with ileum up to the hepatic flexure, including about two

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or three inches of the terminal portion of the cecum. About 24 inches of ileum were involved in the intussusception. The bowel was decidedly blue in color, but after the application of hot saline sponges, the color gradually returned to normal. The general condition was none too good, and it was thought best to do nothing further. The child made a satisfactory recovery and was discharged from the hospital on September 11, 1937.

On April 4, 1938, she had another attack of generalized abdominal pain, which was localized in the right iliac fossa, and was associated with paroxysms of pain, nausea and vomiting and later blood-tinged fluid was expelled from the rectum. There was another large mass palpable in the right lower quadrant.

Surgery was again advised and the old scar was excised. When the abdomen was opened about a pint of blood-tinged fluid escaped. There was a large mass in the right iliac fossa, which consisted of an intussusception of the ileum into the cecum and ascending colon. The entire mesentery of the ileum had been dragged

into the cecum and it was with extreme difficulty that the intussusception was reduced, which had begun about 14 inches from the ileocecal juncture. The bowel was quite blue, in places almost black, but the normal color gradually returned after hot towels were applied. It was noted at this time that the cecum was extremely mobile and it was believed that this played some part in the recurrent attacks of intussusception. So the peritoneum on the lateral wall of the abdomen was split for about 6 inches, and the cecum was placed in a pocket directly against the lateral abdominal wall, and was fixed there by ten interrupted sutures of silk.

There was a moderate amount of operative shock, but the convalescence was otherwise normal and the child was discharged from the hospital on April 12, 1938.

It has now been over three and one-half years since the last operation and this child is perfectly normal and healthy and has had no further attacks of intussusception.



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# New Instruments

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## TIME-SAVING FIRST-AID SPLINT

GEORGE RICHMOND, M.D.

BROOKLYN, NEW YORK

WITH the advent of war and the realization of the dangerous emergency facing the civilian population in the United States such as air-raids, black-outs, lack of protection against gas, and other war hazards brought about by new and terrible situations, novel and better methods of preserving and conserving life and limb must be found. Prior to the present state of international unrest, numerous devices initiated into the art of warfare were devised for the treatment of casualties. Time and confronting difficulties in the treatment of first-aid casualties have of necessity required modification of treatment. Judgment must be efficient these days when "high velocity projectiles often inflict injuries at a distance from the apparent tract of the projectile."<sup>1</sup>

New situations in Britain due to enemy action have even required rejection and curtailment of some of the pre-war carefully accepted methods of treatment. The trial and error type of treatment has brought forth new methods and novel devices for treatment. This has paved the road further but has left much room for improvement for aspects to be encountered in the future. As Professor Zuckerman said before the Royal Society of Medicine,<sup>2</sup> "Neither partial and isolated observations, nor preconceived conceptions of what happens in warfare, can show what these hazards are. The medical problems so acutely raised by air-raids form a new sphere of research which demands in its attack more than simple clinical observation in hospitals." It demands, as I would illustrate, modern ideals of treatment to

suit whatever circumstance might arise from time to time under new unforeseen circumstances and different conditions, reaching above the sea, below the sea, in the air, and involving both hemispheres.

My interest in developing a time-saving first aid splint first came to me during my recent association with a Medical Mobile Unit, A.R.P., in London. The need for a new device for first aid arose after comparing my numerous experiences and contacts with those of other Medical Mobile Units, not only in first aid on the spot, but also for future unforeseen dangers arising from chemical warfare devised to ravage the enemy on a scale unprecedented in the last war. My views and résumé from a practical point of view on the subject are as follows:

*First.* Time and care in mobilization of the wounded greatly curtailed first aid workers in their attendance to other casualties. Since the Thomas splint requires at least two workers and precious six or seven minutes for proper application, the use of a time-saving splint would enable one of two first aid workers to minister to two or three other unfortunate victims. Thus, the assistant could handle nonfracture casualties and allow first-aid workers to synchronize the treatment and application of splints to the victims of fractures. This would permit a spread of treatment for a greater number of casualties in a shorter period of time and thus prevent surgical aid from being<sup>3</sup> "withdrawn forever, from those who are looking to the operator to save their life or limb."<sup>3</sup>

*Second.* The treatment administered to the victim relieves the anxiety of the

casualty, who realizes that attention has been given to him. Thus, the intermediary tendency of secondary shock is somewhat lessened, although primary shock with its shift of plasma leakage from the blood stream into the extravascular tissues, may not be prevented. "Experience of the treatment of wounds during the Great War showed that the time factor between the inception of the wound and its surgical treatment was important in the development of shock."<sup>4</sup>

*Third.* Morphia can be easily given to the victim in a dose of  $\frac{1}{3}$  gr. and repeated if necessary. "Morphia will never kill a man who is in pain."<sup>5</sup>

*Fourth.* This first aid splint can be used for treatment of injuries<sup>3</sup> "in the position in which casualties are found" to the arm and leg with a little simple adjustment without loss of valuable time. Errors may be many at first, but will become fewer as judgment and experiences ripen.

*Fifth.* Wood and canvas can be used instead of metal, thus releasing metal, an important priority item, for other war uses. In addition, wood is lighter than metal in weight.

*Sixth.* With this first aid splint the roller bandage is eliminated and the possibility of Volkmann's ischemic paralysis in the hands of first aid workers is lessened. For this condition arises from interference with blood supply of muscles, often in the elbow, forearm or leg. As was pointed out by Professor Macewen,<sup>6</sup> "the condition may develop within a few hours of the fracture being sustained, and while in some cases it may be due to pressure of the splints, it certainly is not always so." Hence, the elimination of the roller bandage to an injured limb before the swelling and edema have occurred to interfere with the blood supply.

*Seventh.* This time-saving first aid splint can help immobilize and remove a victim quickly from a contaminated area where war-gas containing bombs were dropped over a large area or where aircraft spray of the new modern "vesicants"—mus-

tard or Lewisite, were discharged. This new danger, should it arise, requires rapid removal of the victim from the scene of contamination and first aid treatment immediately applied with<sup>7</sup> "bleaching ointment or other protective ointment, or aqueous bleach paste, over the affected area. This procedure chemically neutralizes the mustard gas." Hence, the essence of time plays an important part in chemical warfare whereby the first aider, dressed in his antigas clothing being drenched with sweat due to improper aeration and expiration, has to immobilize his victim and also to remove him rapidly before these vesicants have a chance to penetrate the skin, either in the liquid or in the vapor state.

From the aforementioned it will be understood that methods of preventing serious injuries have to be applied within a short period of time. Simplicity of application of the splint is the key-note of saving time in convalescence. In the years gone by, prior to the lessons learned from brutal modern methods of warfare, much reliance was placed on the Thomas splint. This was the chief means of immobilization in the last war. The Thomas splint has also achieved its goal in this war. But "the Thomas splint is extremely difficult to manage, and that sore formation in the groin, on the buttock, and occasionally in the region of the anterior superior spine of the ileum are the inevitable sequelae of its employment."<sup>8</sup> "In the first-aid stage, all that is aimed at is the fixation of the fracture and not necessarily its complete reduction, because, if a very strong pull is exerted on the foot through the boot, ulceration and perhaps gangrene may be produced."<sup>9</sup> Yet in the hands of first-aid workers, such danger and difficulty are much greater.

At the beginning of the war in London, demands were heavy on first-aid workers. These first-aiders were given only the essentials of anatomy and methods of handling casualties without indicating essential relationships. However,<sup>10</sup> "in order to understand a fracture it is necessary to

know the structure and function of the bones.”<sup>10</sup> Consequently, I trust that the enthusiasm for simplicity of a new device

ably white-pine. The splint should be smooth and shellacked with a good five-pound-cut shellac, dried for one-half to

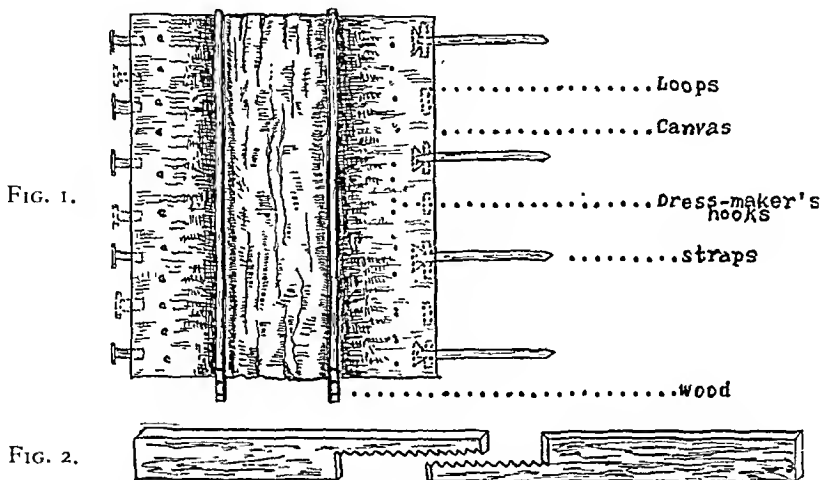


FIG. 1. Illustration of complete Richmond first-aid splint.  
FIG. 2. The splint unit showing construction.

will be hailed, as a new contribution in the application of the principle of immobilization. As Böhler says, "All improvements and innovations can only succeed by making it easier to attain reposition and lasting fixation of the bone fragments, or by making the technique simpler and less dangerous."<sup>10</sup> It is with the intention of obtaining *Simplicity* in the treatment of first-aid casualties that I have devised my time-saving first-aid splint, combining all the essentials of the Liston splint, the long and short osteotomy splints, the Macintyre splint and the Hodgen's splint.

It must be stressed here that my method is the old principle of immobilization, with whatever one has available to immobilize the arm or leg, whether it be "rifle, bayonet, cutlass, sabre, scabbard, a bundle of twigs, broomhandle, shovels, or straw cases for bottles, stuffed one inside the other, metal pipes, newspapers wrapped up as they are when they come by post, or bamboo of various sizes and lengths make excellent material."<sup>11</sup>

#### DESCRIPTION OF APPARATUS

*The Splint.* The splint (Fig. 1) is comprised of simple pieces of wood, light in nature and of good tensile strength, prefer-

three-quarters of an hour before use in order to prevent the wood from warbling. The thickness is  $\frac{1}{2}$  inch to  $\frac{3}{4}$  inch and the width is 5 inches. The length is 15 inches for one-half of the splint. Bevelled teeth are cut out 8 inches from one end, that is, distal from one end, and the width of the teeth should be  $\frac{1}{2}$  inch wide for the other bevel teeth to set into the groove. The teeth should start 2 inches from the superior surface (top) of the splint, and the teeth should be  $\frac{1}{2}$  inch wide. (Fig. 6.) When the two halves composing the splints are placed together, the width of the splint should coincide as one piece of wood. (Figs. 2 and 7.) The teeth are cut slightly upward in order that they will not slip out when tension is applied. The bevels serve the purpose of shortening or lengthening the wooden splints as needed.

*The Binding.* The two splints are attached to elastoplastic bandage, which stretches when pulled apart. An allowance of 4 inches between the splints should be provided. This play allows the splints to be secured when stretched an additional 2 or 3 inches if a stout person is encountered. The elastoplastic bandage is wrapped completely around the splints to form a pocket (Fig. 4) and is sewed with some

good thread, defending the skin from the pressure of the wood producing the aggression of splint sore.<sup>11</sup> In addition, tow

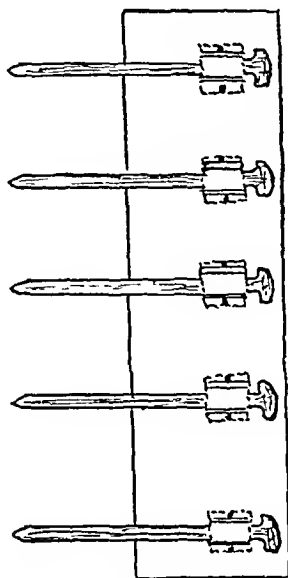


FIG. 3. The side envelopes and the strap unit construction.

or cotton wool is used for the padding, or "some clothes or a handful of straw wrapped"<sup>11</sup> in the splint to help minimize and arrest the painful splint sore. Furthermore, this tow or cotton wool prevents ravaging the circulation and at the same time helps to combat the sodden area by making the splint tense, thus acting to support the splint and supplement immobilization of the segments of the fracture.

*The Side Envelopes.* These are made of good strong canvas and sewed on to the pockets of the elastoplastic bandage with twine (Fig. 5), thus re-enforcing the pocket supporting the wooden splints. The width of the side envelopes should be 6 inches with one envelope overlapping the other envelope. Side straps (envelope notches) should be sewed on the outer side of the side envelopes (Fig. 3), that is, on the exterior surface 4 inches apart for leather straps—or for some good cord to enter—in order to grasp the other envelope on the opposite side, thus binding the splints and fixing them firmly. Eight or ten fixation

strap notches are sufficient, while five or six straps are sufficient to immobilize the segments of the fracture. In addition, simple

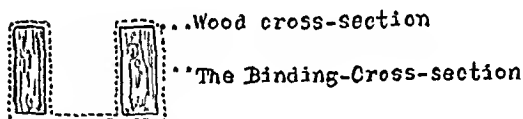


FIG. 4.

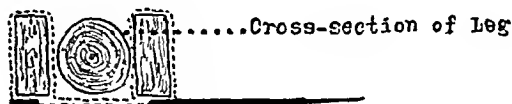


FIG. 5.

FIG. 4. Transverse section of the binding with the wood splint.

FIG. 5. Transverse section of entire construction.

dressmaker's hooks are sewed on the inner side of the side envelope toward the upper end, about 2 inches from the superior free edge with the other catch hook on the outer envelope 2 inches from its inferior free edge in order to make use of the hooks binding the splints.

*The Straps.* The straps (Fig. 8) are to be 8 or 9 inches long made of calico, leather, canvas, or muslin impregnated with washing starch with a wedge T-shaped on one end stiffened with several layers sewed together about  $\frac{1}{2}$  inch thick. This edge fits into the aperture of entry of the canvas envelope notch to act as a grasp. A fitted buckle with no eyes but having a movable catch bar, similar to a student's book straps, is attached to the other side envelope toward the inferior edge or bottom, near the elastoplastic bandage pocket, in order to fix the splint, (Fig. 9).

Concomitantly, to prevent foot drop various V-shaped notches (Fig. 7) have been cut out on the upper part of the wooden splints, beyond the free edge of the elastoplastic bandage, that is, the last 8 or 10 inches beyond the shoe, thus helping not only to lift the leg or arm in transit without disturbing the patient, but serving also as a support to the leg. Likewise, a modified Carr's splint for the treatment of a Colles' fracture can also be made by placing a piece of broom handle obliquely across the end of the top of the V of the breadth of the wrist. In addition, a V-shaped  $1\frac{1}{2}$  inch notch can be made on the free distal edge or a 1 inch

hole burrowed for any extension to be used in the treatment of a Pott's or a Dupuytren's type of fracture. (Fig. 7.) To be

reaches the hospital, where he can receive the permanent treatment." Hence, sufficient traction and countertraction of 15 to

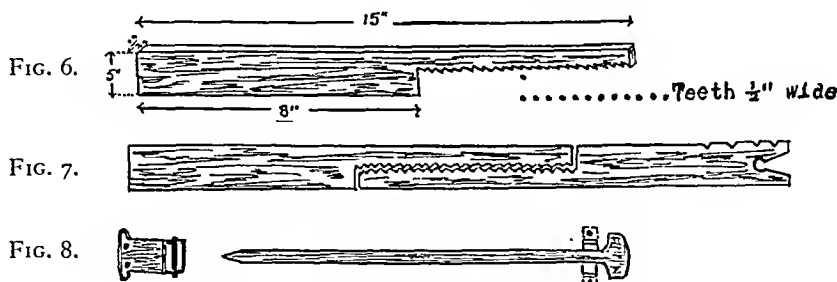


FIG. 6. Construction of one-half of the splint.

FIG. 7. Illustrating how the splints coincide as one piece.

FIG. 8. The strap construction.

permanently effective in the treatment of a Pott's type of fracture, the space of the heel is padded in with a large mass of tow, cotton wool, rags or anything available at the time below the external malleolus placed along the outer side of the foot and the foot is placed in the position of inversion. In an emergency with a Dupuytren's type of fracture, relief may be obtained by

20 pounds pressure are applied on the spot sufficiently to reduce the fracture, to keep the segments in line, to relieve pain, and thus immobilize the segments before removal to a hospital, thereby preventing a simple fracture from becoming a compound fracture.

After immobilization, a dose of  $\frac{1}{3}$  gr. of morphia is administered and the letter M  $\frac{1}{3}$  or M/3 gr. is inscribed on the patient's forehead with a skin pencil and the letter M is also inscribed on the canvas envelopes. Hence, double precaution is taken against any unexpected catastrophe. These splints, I believe, relieve the pain much better and in addition safeguard the patient's handling back to the casualty depot or hospital. Furthermore, with relief of pain, secondary shock is thus greatly reduced. Besides, the splint is comfortable to the patient and can easily be sterilized in the ordinary way and used again.

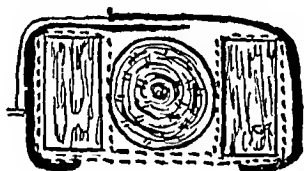


FIG. 9. Cross section of application of the splint.

simply thrusting a "folded towel next to the skin"<sup>6</sup> with the lower end of the towel above the internal malleolus. Backward displacement is prevented by padding in the space behind the heel.

#### APPLICATION OF SPLINTS

The victim is laid on his back carefully in order to minimize the damage sustained from the injury. The leg or arm is lifted carefully and the time-saving splint is slipped under the injured part and applied as indicated after slight traction and countertraction have been administered. "The pull required to reduce a fracture of the femur, and maintain it in position, is very great especially in the case of a simple fracture, and is applied when the patient

#### CONCLUSIONS

1. In the hands of any carpenter hundreds of these splints can be turned out and can be made for a few pennies each. In between calls, first-aid workers and Red Cross volunteers can be taught to sew these splints and become efficient in its manufacture.

2. It is a system of simple construction and simple treatment which will produce satisfactory results when several hundred casualties appear all at once on the spot.

3. This device can be modified to suit the occasion and I believe will prove manageable to suit new types of casualties that may arise.

4. The splint is a speedy device to immobilize and to remove the victim from contaminated areas under conditions of chemical warfare.

#### SUMMARY

1. A device for the saving of time in splinting is described.

2. The device is comfortable to the patient.

3. A method of constructing a cheap splint for any occasion is described.

4. The splint may be used for treating an arm or a leg with little adjustment.

5. Modification of the splints can be made to suit any occasion that may arise.

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# A SHIELD TO SIMPLIFY THE ADMINISTRATION OF INTRAVENOUS THERAPY

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THE constant emphasis on the importance of maintaining body fluids and electrolytes, and the increasing de-

forts of receiving venoclysis with the arm strapped on rigid boards and tied to a bed. Apart from the soreness of the arm and



FIG. 1. Intravenous shield.

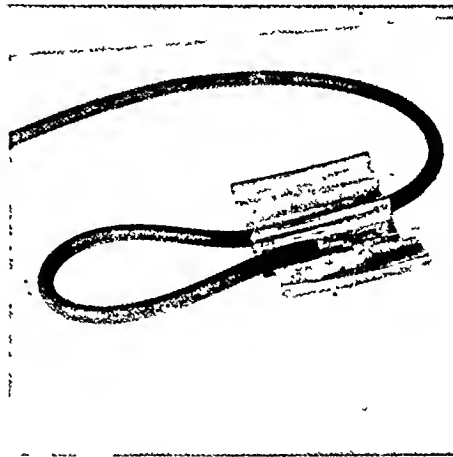


FIG. 2. Relation of needle to undersurface of shield.

mands for intravenous medication with its many advantages of rapidity of administration, more accurate dosage and ease of maintaining optimal blood levels make the

stiffness of the elbow, the older method violates one of the more important principles of good nursing, for the board and the bandage immobilize not only the arm but practically the entire body during the period of intravenous administration. The movements of the body in bed are greatly restricted and in continuous intravenous therapy, over a period of days, this might invite circulatory hypostasis with its undesirable complications, and make the problem of nursing difficult to the nurse and hard on the patient.

To obviate some of the discomforts of the rigid arm board, and the drawbacks to prolonged immobilization of the patient in bed, this shield (Fig. 1) has been devised. The shield is a plate of aluminum moulded to conform to the convexity of the arm, while its edges are rounded so as not to injure the skin. It has a tunnel on its undersurface to accommodate the needle

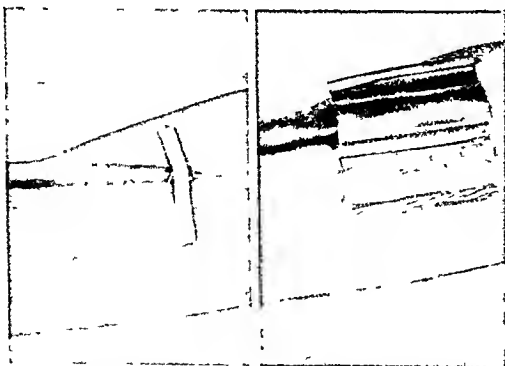


FIG. 3. Needle inserted into vein and anchored to skin.

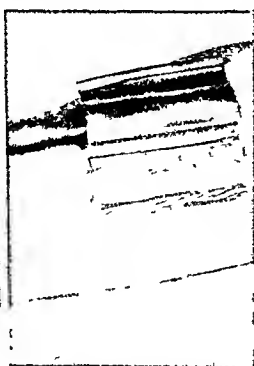


FIG. 4. Shield applied to forearm.

simplification of the intravenous technic of therapy a very desirable achievement. Everyone is familiar with the discom-

and observation tube while across its uppersurface runs a deep groove in which the rubber tubing can lodge securely. (Fig. 2.)

vein below the crease of the elbow so that the arm may not only be free to move but also free to bend preventing the elbow from stiffening at the termination of treatment.

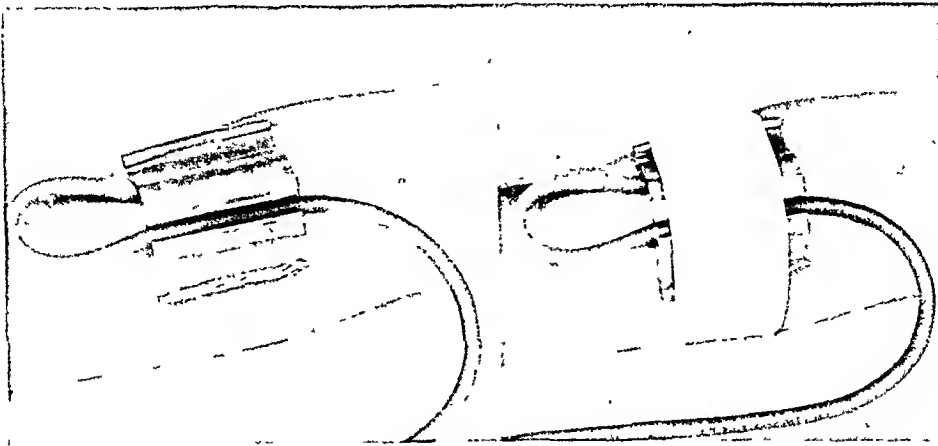


FIG. 5. Rubber tubing inserted into groove on dorsum of shield.

FIG. 6. Shield strapped down to arm with adhesive strip.

Once the needle is inserted into the desired vein, and its hub or the observation tube when used, anchored to the skin with a narrow strip of adhesive (Fig. 3), the shield is applied on the arm with its concavity downward and the tunnel over the needle and observation tube. (Fig. 4.) The rubber tubing is then repositioned into the groove in the dorsum of the shield (Fig. 5), and the shield is secured in place with an adhesive strap. (Fig. 6.) After the administration is over, the shield may be removed by inserting the scissors into either one of the grooves on its sides beyond the curled edges and the tape cut.

It is advisable, when possible, to select a

#### SUMMARY

A shield to facilitate the administration of solutions by vein is here described. The following are its advantages:

1. It obviates the use of the arm board and the torture its use entails.
2. It affords better protection to needle and glass adapter, and permits the covering of the arm with bed sheets instead of leaving it exposed.
3. It permits free movement of the patient in bed and, when possible, bending of elbow, thereby lessening the dangers resulting from circulatory stasis.
4. It facilitates nursing care by permitting freer movement of the patient in bed.



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# Bookshelf Browsing

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## THAT WAS NO LADY

A REPLY TO MR. STOUT IN WHICH ARE INCLUDED SOME OBSERVATIONS UPON  
THE NATURE OF DR. WATSON'S WOUND

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### I. THAT WAS NO LADY

UPON entering into a literary controversy with Mr. Stout, one is immediately conscious of being at a great disadvantage. It would require the knowledge and the pen of Edgar Smith, the experience and the skill of Vincent Starrett, as well as the genius and the beard of Christopher Morley, to equalize the contest. However, no matter what the odds may be, it is necessary for the Irregulars to reply to Mr. Stout's preposterous assertion that one of their heroes is not even a heroine. It is a fellow *man* that is to be defended, and the challenge must be answered. - - -

Needless to say, all true Irregulars have been amazed by the theory that John H. Watson, M.D., Late Indian Army, was a nom de plume for Mrs. Irene Holmes. As a theory it has one inherent fault; it is intrinsically impossible. However, Mr. Stout has supported it by quotations from the Sacred Writings (rivaling the often remarked ability of another bearded personage to quote scriptures for his purpose) and therefore it cannot be lightly dismissed. Fortunately, the same stories from which the quotations are drawn furnish material to prove definitely and for all time that the entire hypothesis is contrary to the known facts.

The first series of quotations is taken from *A Study in Scarlet*. But in this very story we are told that Dr. Watson received

his degree of Doctor of Medicine at the University of London in 1878 and then proceeded to Netley to go through the course prescribed for surgeons in the army. Subsequently, he was attached to the Fifth Northumberland Fusiliers and was wounded at the battle of Maiwand. It is not necessary to point out that no woman did all this—and also frequented the Criterion Bar and smoked ship's tobacco.

Then we have a quotation from *The Empty House* dealing with Dr. Watson's fainting spell. However, this quotation ends in a blank which conveniently omits the words "for the first and last time in my life." By this omission the sense of the text has been altered. A man has to explain a fainting spell. No woman would find an explanation necessary. On the contrary, the dear ones seem proud of this weakness and have been known to simulate it on occasion.

The samples already analyzed will convince the most Irregular mind that it is not necessary to discuss each quotation in detail. However, a brief glance through the writings will reveal numerous significant incidents. Sherlock Holmes would hardly have sent his wife away overnight to an obscure corner of Essex in the company of Josiah Amberley. Certainly it was not Mrs. Holmes who expressed disappointment because Sherlock manifested no further interest in Miss Violet Hunter when once she had ceased to be the center of one of his problems. Even Mr. Stout will

not insist that it was Mrs. Holmes who, revolver in hand, dashed into a prehistoric hut on the Devonshire moors in search of a desperate criminal. No, it is quite apparent that any attempt to identify Watson as a woman, and specifically as Irene Adler, is a futile one, especially when we consider that Irene is not pictured in a very favorable light. In fact, because of the way her character is revealed in the *Sacred Writings*, she is toasted only at Irregular gatherings at the present time.

As a final clincher we have only to quote Watson's description as obtained by Lestrade from the members of Milverton's household: "He was a middle-sized, strongly built man—square jaw, thick neck, moustache . . ." Obviously Mr. Stout will have to *cherchez* elsewhere for *La Femme*. Just one hint—like Lady St. Simon, Mrs. Holmes is a myth. There is not, and there never has been, any such person.

## II. SOME OBSERVATIONS UPON THE NATURE OF DR. WATSON'S WOUND

One trusts that the theory of Dr. Watson's femininity has by now been demolished. However, Mr. Stout has succeeded in demonstrating that the good doctor did possess a certain petulance usually associated with the female rather than with the male sex. The presence of this characteristic leads the logical mind to deduce that there was a deficiency somewhere in Dr. Watson's make-up. What is more natural than to associate this with his wound? We are able to refer to a parallel case that occurred in one of the English counties during the early part of the eighteenth century. This involved Mr. Toby Shandy, Tristram's uncle, and it is to Mr. Laurence Sterne that we are indebted for a detailed description. Uncle Toby was an amiable gentleman, not very astute, who served as an audience for the intellectual Mr. Shandy, Sr. When we add that Uncle Toby was an army officer, retired because of a wound that bothered him considerably, we have established a

very close parallel between him and Dr. Watson.

Let us consider the parallel cases in greater detail. Uncle Toby's wound involved his groin and Mrs. Bridget described it by "—holding the palm of her left hand parallel to the plane of the horizon, and sliding the fingers of the other over it, in a way which could not have been done, had there been the least wart or protuberance." Dr. Watson's wound was not so minutely described, and it is this fact that accounts for the confusion that has existed up to the present time. However, while it is obvious that one wound did not involve his leg and his shoulder, it is reasonable to assume that the wound was located half way between the parts mentioned. In other words, it was a wound just like Uncle Toby's. Naturally, Dr. Watson, writing during the reign of a certain gracious lady, could not be as frank as Tristram Shandy in the days of the Georges.

Now Uncle Toby was unsuccessful in his marriage proposal because of his wound (" . . . when one is married, one would choose to have such a thing by one at least"). It is true that Dr. Watson did get married, but evidence has been presented to show that his marriage, or marriages, did not turn out as happily as could be expected.\* When our attention is drawn to the strange incident of Watson's children and to his evident preference for the cold type of woman, as exemplified by Violet de Merville,† we may consider the matter definitely settled. Each fact is suggestive in itself. Together they have a cumulative force. The two cases and (what is more important to us) the two wounds were exactly parallel.

Now, let us calmly define our position. There is no good reason to assume that anybody (except perhaps some unusually conscientious Irregular) has read up to this

\* Davis, Elmer: *The Emotional Geology of Baker Street*, in 221B, *Studies in Sherlock Holmes*.

† Mr. S. C. Roberts has suggested that Dr. Watson married her.

point. Any one who has done so will realize that this essay has disproved the false theory of Dr. Watson's sex, discredited the science of acrostics, and discovered the true nature of Dr. Watson's wound. This makes it a rather ambitious undertaking and it is vain to hope that more can be accomplished

in an article of reasonable length. Therefore, it is only fitting that we cease prying into the most intimate affairs of Dr. Watson and allow him to enjoy his stay in that special Valhalla, together with the best and the wisest man we have ever known.



CONTENTION is made that the malignant uterus has lost its right of residence and should be removed in every instance where such is possible. From—"Vaginal Hysterectomy" by James William Kennedy and Archibald Donald Campbell (F. A. Davis Company).

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## Editorial

### ESTABLISHMENT OF CARTILAGE DEPOTS FOR MILITARY AND CIVILIAN USE

**R**ESERVES! Reserves! This seems to be the byword of our present day existence. Whether they are for defense, offense, or our own consumption, whether animate or inanimate, properly prepared, adequate reserves when soundly applied to the fullest capacity, will be the eventual positive answer to the successful culmination of the fight for "our way of life."

With the above thoughts in mind and knowing full well there will be considerable call in the future, I would like at this time to outline a simple but effective plan for the mass conservation of cartilage for either the immediate or subsequent use as cartilage grafts for reconstruction surgery.

The plan would be the establishment of cartilage depots in all military or civilian hospitals under proper supervision, where this type of graft would be used in its many phases of plastic and reconstructive surgery.

Since my original work ten years ago on what I called "Refrigerated Cartilage Isografts," numerous reconstructive surgeons throughout the country have successfully employed preserved cartilage grafts in dealing with their many reconstructive problems. From my own experience and from personal communications from other reconstructive surgeons, the use of preserved rib cartilage grafts in surgery as a permanent contour builder, supporter, and

defect filler is now a scientifically proved fact.

The cartilage is obtained from human material preferably between the ages of eighteen and forty-five. The glistening white cartilage obtained from muscular individuals between the ages of eighteen and thirty is the ideal material. This cartilage is larger, heavier, preserves better, curls less, and is more suitable for sculpturing. With the wealth of available cartilage in the human body, one may be very select as to the donor. I use cartilage from individuals in the proper age group, who have met sudden death through some accidental means, excepting, of course, poison deaths. A Wassermann is done on the heart blood to prevent any medicolegal complications. Individuals who have, as their cause of death, tuberculosis, lues, septicemias, or other acute or chronic transmittable diseases, should not be used for donor subjects. One can readily see that, with the large number of accidental and functional deaths, a continuous and practically inexhaustible cartilage supply is available.

The cartilage isografts may be used interchangeably, regardless of race, sex, color, age (within certain limits) or blood grouping. The types of cartilage used to date have been septal (not reliable), ear (partial or total), articular (few), and any of the sections of costal cartilage which is the main source of supply. The cartilage may

be removed aseptically, if so desired; but this being unnecessary the cartilage is removed under clean conditions, completely cleared of any attached tissue and its perichondrium, washed with normal saline and then placed in a sterile container. The cartilage is then completely covered, by at least one inch, with a solution of one-part aqueous merthiolate (1-1000) and four parts of normal salt, called "merthiosaline," for purposes of identification. This container is then placed in the refrigerator in the hospital laboratory and left there continuously, being removed only when cultures are taken or the cartilage isograft is to be used for a transplant. After a new cartilage has been obtained, it is left in the original container for one week and then transferred, using aseptic precautions, to another sterile container and again submerged in the "merthiosaline" mixture. The "merthiosaline" solution should be changed every two to three weeks. The cartilage is not used unless the donor has a negative Wassermann, and until the isografts have had the refrigerated "merthiosaline" treatment for one week and two negative cultures have been returned. To date a positive culture has not been returned from the stored material covered with the "merthiosaline" and kept in the refrigerator as described above. I have used cartilage that has been stored for two years, but the cartilage that has been preserved six months or less is more satisfactory.

The cartilage isograft is very versatile in its application. I have used it to correct bony or cartilaginous defects of the head, face, chin, nose and orbital rim. On several occasions, due to depressed fractures of the orbit, I have used it subperiosteally in the floor of the orbit, as a wedge, to elevate the eyeball to its normal position. The cartilage of the pinna has been utilized *in toto* or in part for total or partial reconstruction of the external ear, following traumatic loss or congenital absence of the ear. It has proved of value as a supportive and contour element in ear reconstruction, and necessary in the restoration of deformed "cauliflower" ears to normal.

There are certain precautions that must be taken if one is to obtain the best possible result when using refrigerated cartilage isografts:

When the cartilage grafts to be used for transplants have been finally prepared they should be handled under the most aseptic conditions, not being touched by the gloved hand or permitting the cartilage to rub against the skin when introducing it into its recipient area. The pocket that is to hold the graft should be as close as possible a replica of the graft to be used, but the graft should not be under tension, so that all unnecessary dead spaces are eliminated and hemostasis of the area to be grafted should be complete. The grafts should be accurately splinted internally or externally, but preferably by both methods. These grafts may be used as replacement structures in fresh injuries only if the injury is of such a nature that one is justified in doing a primary closure, if the cartilage grafts can be completely covered without tension and if all of the requirements for the utilization of a free graft can be met.

In using refrigerated cartilage isografts, since the advent of the sulfa group of compounds, I have made an additional change in technic. All cartilage grafts are now used in conjunction with sulfanilamide locally. The grafts were first covered with the sulfanilamide powder and then placed in their bed. This made handling of the graft somewhat difficult, so at present the bed that is to hold the graft is completely covered with a fine film of the sulfanilamide powder blown in by an atomizer and then the graft placed in position. Although this is a relatively new development in technic, to date I have not had any untoward symptoms either locally or generally. In fact, the combination has definitely increased the conditions under which these grafts can be used.

The establishment and maintenance of cartilage depots can be accomplished with a minimum amount of effort and a negligible cost, and once established they would be of inestimable value to the surgeons who are called upon to do the reconstructive work.

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# Original Articles

## KELOIDS\*

### REVIEW OF THE LITERATURE AND A REPORT OF EIGHTY CASES

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THIS contribution is a report of eighty patients with keloids whom we treated in private practice and at the Department of Dermatology and Syphilology of the New York Post-Graduate Medical School and Hospital during the years 1929 to 1940. We have also reviewed the literature to date to facilitate discussion of the various phases of the subject of keloids, with special reference to theory and therapy.

Keloid was originally called *cancroide*.<sup>1</sup> Alibert first described keloid in 1814 as a "shellfish with processes like legs implanted into the skin." The name keloid is derived from the Greek *χηλή* meaning a claw.<sup>2</sup> The synonyms are *cheloid*, Alibert's *keloid*, *kelis*, *Knollenkrebs* in German and *cheloïdes* in French.<sup>3</sup>

Keloids are benign proliferative fibrous tissue overgrowths having their origin in the subpapillary plexus of the cutis and developing as a result of trauma. They are characterized clinically by hard, raised, shiny, usually smooth sometimes corrugated, hairless growths. They may be pink or red, white or brown according to their pigment content, vascularity and age. Their surfaces are often covered with telangiectatic capillaries. They may range in size from a quarter of an inch to several inches or more and may be oval, round, linear, irregular, in bands or ridges, bizarre shaped or button-like. (Fig. 1.) They form

an abrupt transition and only rarely a gradual transition into the surrounding skin, frequently with claw-like prolonga-

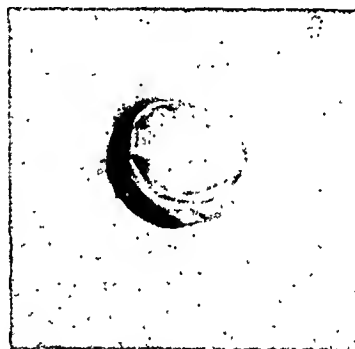


FIG. 1. Case 78. Keloid on shoulder developed spontaneously (following pustule?). Keloid was excised and new button-shaped keloid developed which was later treated with x-rays. Post-treatment photo was lost.

tions. Keloids may be single or multiple, as many as a hundred or more, as shown by our Case 75 (Figs. 13, 14, 15 and 16) and as reported by de Amici.<sup>4</sup> They are usually situated in the longitudinal folds of the skin. They may be painful and tender and occasionally itchy. It may take months or even as long as twenty to forty years before they attain their maximum growth. Keloids have a frequent tendency to recur irrespective of the method used in their removal, whether by scalpel, electrosurgical knife, electrodesiccation, etc. In rare instances keloids may ulcerate, and they have been

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known to become malignant.<sup>5</sup> An unusually extensive case of keloids with ulceration and hyperkeratosis is described in special Case v.

Keloids are still classified as true and false. The former are also spoken of as spontaneous, genuine or idiopathic and the latter as secondary, spurious or cicatricial. The newer conception is that even the spontaneous keloids are caused by an injury so slight as to have escaped the attention of the patient, such as mosquito bites, pressure, scratching, irritation, comedos and infections. There is no difference pathologically between the spontaneous and secondary keloids.

#### ETIOLOGY

While an injury is the immediate cause of all keloids the primary reason for these growths is still unknown. There are probably a number of factors that interplay and are responsible for their production. The various theories that have thus far been advanced are discussed later in this article.

Among the predisposing factors age and race are known to play important rôles. Endocrine disturbances and increased hormonal stimulation or imbalance probably have a great influence in promoting these tumors. While keloids appear at all ages, they are most common in the young and rare in the aged. The greatest number of keloids in our series occurred between the ages of ten to twenty years. There were eleven in the first decade, twenty-three in the second, fourteen in the third, twelve in the fourth, five in the fifth, and two in the sixth, making a total of 67. In thirteen cases the age was not stated. There were forty-eight female and thirty-two male patients, the oldest being fifty-eight years. The duration of the keloids was from one to many years.

Naegeli<sup>6</sup> in an examination of 3,335 healthy school children found keloids in 151, an incidence of 4.5 per cent. Below the tenth year keloids predominated in boys, while between the ages of ten and fifteen years there was only a slight difference

between the sexes. In 843 adults examined 118, or 13.3 per cent, had keloids. In 530 hospital patients of children and adults suffering from various acute and chronic diseases the incidence of keloids was found to be much higher than in healthy persons. In forty-nine patients with tuberculosis eleven, or 22.4 per cent, had keloids. The preponderance of keloids existed in vaccination scars. While these figures seem to be unusually high they may be explained by the probability that we included hypertrophic scars with keloids, thus enormously raising the percentage.

Negroes, Hindus and Malaysians<sup>7</sup> are said to be more likely to develop keloidal growths than whites. The syphilitics and the tuberculous are likewise supposed to be more prone to develop keloids than others not so affected. Fox<sup>8</sup> found three cases of keloids in 3,382 white patients and seventy-six cases in 11,486 negroes, a ratio of negro to white patients of about 19 to 1. Hazen<sup>9</sup> saw one keloid in 2,000 white patients with cutaneous diseases but fourteen keloids in the same number of negroes. Matas<sup>10</sup> estimated the ratio of keloids in colored to white patients as 9 to 1. According to Grosse<sup>11</sup> this preponderance of keloids in the dark-skinned races is due to the practice of scarification in Africa, Australia, Polynesia, etc., for tribal, religious or sexual motives. While keloids are universally regarded as a disfigurement they are looked upon as beauty marks in Sudan, (Engelsen<sup>12</sup>) Malaya, Australia and other regions. In our eighty cases there were only three colored patients. This can easily be explained by the fact that very few colored patients apply for admission to our skin department and that white patients are more likely to seek advice and treatment for keloids.

The opinion that syphilis and tuberculosis are etiologic factors in promoting keloidal growths was not supported by our study. Thirty of our patients and seventy-eight out of 168 other patients with keloids of the Department of Dermatology of the New York Post-Graduate Medical School

and Hospital who had a Wassermann test taken gave negative serologic reactions. Among these patients (168 plus 80) only

Keloids followed acne lesions in nine patients, or 11.2 per cent. There were three cases of spontaneous resolution. (Fig. 2.)



FIG. 2. Case 79. Illustrating keloidal scars following extensive burns with spontaneous regression without treatments within two years.



FIG. 3. Private case of Dr. George Miller MacKee. It illustrates keloids developing in herpes zoster lesions on the shoulder.

one was known to have syphilis. None of our patients presented clinical evidence of tuberculosis either in the bones, glands or lungs. Nine patients gave negative and three patients gave positive reactions to tuberculin in concentration of 1:10,000. This is within the normal limits. According to Martenson and Noll<sup>13</sup> 18.5 per cent of normal individuals react positively even in concentration of 1:1,000,000.

Keloids have a predilection for the sternum, back of the chest and lobes of the ears. The sternal region is the favorite location of spontaneous keloids (according to Smith<sup>14</sup> 50 per cent) where they are usually situated at right angles to the long axis of the sternum. However, no part of the body is exempt from keloid formation. Werner Schmidt<sup>15</sup> and Mook<sup>16</sup> reported keloids on the tongue. In Mook's case the keloid followed electrodesiccation of a wart.

In fifty-five of the eighty patients (67 per cent) the keloids were located on the upper half of the body. This is probably due to the greater exposure of that part of the body to injury and to the frequent occurrence of acne vulgaris on the face, chest and back.

There is occasionally a family tendency to keloids. Gate and Coste<sup>17</sup> reported keloids in father and daughter. Similar occurrences have been reported by Wilson,<sup>18</sup> Hutchinson<sup>19</sup> and others. Hebra<sup>20</sup> reported keloids in a mother and her three daughters, Finsen<sup>21</sup> in two sisters, Neugebauer and Schramek<sup>12</sup> in three or four generations. In Case 54 (Table 1) father and daughter had keloids. Congenital keloids were reported by Bryant and Rosenthal.<sup>12</sup>

As already stated keloids may follow burns, cuts, bruises, surgical incisions, tattoo marks, acne, herpes zoster,<sup>22</sup> small pox, vaccinia, insect bites, etc. (Figs. 3, 4 and 5.) They may follow morphea, psoriasis, fibromas and lipomas.<sup>23</sup> A very unusual case of an extensive keloid developing spontaneously on a nevus (flammeus?) of the scalp is described in special Case iv. (Figs. 23 and 24.) Sutton and Sutton<sup>24</sup> show a remarkable photograph of a drug addict who presents numerous closely grouped match head-sized keloidal growths, most abundant on the ventral surfaces of the trunk and limbs. J. Margat<sup>25</sup> reported a

case of a young woman with hyperthyroidism who developed keloids under the chin following electrolytic treatments for hyper-

case<sup>27</sup> in which keloids developed in tattoo marks tattooed red and not in those tattooed green.



FIG. 4. Case 77. Showing keloids in both lobes of the ears after piercing for earrings.



FIG. 5. Same Case 77 as in Figure 4.

trichosis. Her father also had keloids. One of our patients, a girl aged seventeen, developed keloids on the upper part of the left arm and shoulder two years after the removal of superfluous hair by electrolysis. Her father likewise was known to have keloids.

Keloids may develop only in some out of many scars because of regional susceptibility. This is exemplified by our patient, a woman aged thirty-three, with congenital syphilis (Figs. 6 and 7) who after a year of antisypilitic therapy had a plastic operation performed for the absence of the columella and destruction of the nasal tip following a gumma. The flap was taken from the outer surface of the left arm. A keloid developed three months later on the arm at the area of incision but not on the nose during a period of two years. A similar case demonstrating local susceptibility was presented by Dr. Fox<sup>26</sup> at the New York Dermatological Society. The patient, a woman aged forty-three, developed keloids on the back, shoulders and sternum but not at the site of an appendectomy scar. Dr. MacKee in discussing this case stated that tendency to keloid formation is not necessarily generalized but may be limited to one part of the body.

Keloid formation may depend upon the nature of the irritant and character of irritation as demonstrated in Welanders's

Clare<sup>28</sup> suggests that some ovarian tumors may be looked upon as keloidal overgrowths of fibrous tissue. Schridde<sup>29</sup> describes keloidal lesions involving the throat, lung and stomach. He introduced the term "keloidosis," incorporating pneumoconiosis and similar occupational lesions. Morison<sup>30</sup> states that keloids occur in the mouth as epulis, in the stomach as linitis plastica and in the cecum as hyperplastic tuberculosis in which the tubercle bacillus is not found. According to Bohrod<sup>31</sup> elephantiasis and fibrous stricture of the rectum may be due to a fibroplastic diathesis. Rectal strictures are known to be manifestations of lymphogranuloma inguinale; all the cases reported by Cole<sup>32</sup> and Bloom<sup>33</sup> gave a positive Frei reaction. However, since only some patients with lymphogranuloma inguinale develop esthiomene and rectal strictures, the fibroplastic diathesis or hormonal factor may conceivably be the underlying cause.

#### THEORIES

Sabouraud<sup>34</sup> was of the opinion that keloids are caused by the tubercle bacillus, stating that the "tuberculous nature of keloids is beyond question." This was refuted by Pautrier and Glasser.<sup>35</sup> They ground up keloidal tissues from two patients with keloids and from one patient with acne keloid which they injected subcutaneously into the abdomen and intra-

dermally in the back of guinea pigs and rabbits. These animals were observed for months and no local nor general lesions

Case 21) and in several of our other cases in which subepidermal sutures were used. These wounds, although they healed rap-



FIG. 6. Case 76. Congenital syphilis, illustrating regional susceptibility to keloids. Keloid did not develop on the nose on which a plastic operation was done for absence of columella when seen at six months and a year later.



FIG. 7. Case 76. Showing a large keloid on the arm from which a flap was taken for the plastic operation on the nose.

were noted. Similar experiments were carried out by Naegeli,<sup>36</sup> Wartin, Drouet<sup>37</sup> and Marras<sup>38</sup> with negative results. Serologic tests with the antigen extracted from keloid tissue have given negative results as to the tuberculous element.<sup>39</sup>

Pautrier<sup>40</sup> attributes the formation of secondary keloids to the slow elimination of necrotic material and delayed epithelization. It thus prolongs the exposure of the collagen without the benefit of the protective, compensatory and stabilizing influences of the epithelial tissue. Similar ideas are promulgated by Lortat-Jacob, Fernet and Solenti.<sup>41</sup> They, too, attribute keloid formation to the loss or diminution of the protective influence of the epidermis, which acts as a control and normally exerts an antagonistic action against the proliferative properties of the derma. "When that action is diminished or lost the balance between the two antagonistic forces is disturbed so that even small stimuli are able to cause pathologic overgrowth of the true skin." These theories do not account for the keloids that follow even those wounds that heal by primary union (Fig. 8,

idly, were later followed by widening of the scar and keloid formation. Neither do these theories explain those cases of slow granulating, infected wounds of which only a fraction of 1 per cent develop keloids. Alibert<sup>42</sup> classified keloids as cancerous dermatoses, but keloids as clearly seen by histologic sections do not show the structure of an epitheliomatous degeneration. He may have formed his opinion by the crab and claw-like nature of these growths. An error might occasionally be made by the resemblance of the dense formation of the fibroblasts of the keloidal section to the spindle cells of sarcoma. Such an error was made in special Case III by the general pathologist who erroneously diagnosed the growth as fibrosarcoma.

Experimental evidence seems to link the glands of internal secretion to keloid formation especially the thyroid, parathyroid, thymus, ovaries, testes and spleen. Justus<sup>43</sup> believed that there is a close relationship between the thyroid gland and keloidal development. He induced keloidal growths in persons suffering from hyperthyroidism by irritating the skin "with

exitant pharmacologic substances, the activity of which was slight." Leriche and Jung<sup>38</sup> likewise reported that hard fibrous

tribution of the calcium it was revealed that there was a distinct decrease of the salt in the keloids as compared to the



FIG. 8. Case 78. Illustrating recurrence of keloid in scar after excision.

patches (keloidal?) in a woman patient gradually regressed following a unilateral resection of the inferior thyroid gland on that side. Balassa<sup>38</sup> noted that after the injection of thyroid extract following a thyroidectomy keloids were formed.

Pautrier and Zorn<sup>38</sup> found a hypercalcemia in the blood and in the keloids in 75 per cent of cases (nine out of twelve) and a constant increase of this salt in all the keloid tissue. These findings lead Marras<sup>38</sup> to believe that keloid formation may be attributed to hyperparathyroidism which results in hypercalcemia. He believes that experiments and studies of the disease on disturbance of the calcium metabolism of the collagen tissue may solve the problem of the etiology of keloids.

Jung and Chinase Hakki<sup>45</sup> found hypercalcemia in four and normal calcium contents in five cases of spontaneous keloids. There was an increase of calcium in the keloid tissue as compared with normal connective tissue (0.221 to 0.654 in fresh tissue and 0.881 to 2.298 in dry tissue against 0.051 in normal skin expressed in mg. per cent, Nathan and Stern's micro method). However, with the MacCallum, Cretin, de Grandi and Mainini technic used for the purpose of studying the topographic dis-

tribution of the calcium it was revealed that there was a distinct decrease of the salt in the keloids as compared to the normal skin. This indicates that the calcium which is increased in the collagen of keloid tissue is calcium combined with albuminoid molecules, which can be revealed only by chemical methods respecting this combination but not by stains breaking up the intricate molecular structure.

In our most extensive case of keloids (Case 75, Figs. 13, 14, 15 and 16) the calcium content of the blood was normal, (10.1 mg. per 100 cc., the normal varying from 9.5 to 10.5 mg.).

Marras<sup>46</sup> found in several patients with keloids signs of endocrine dysfunction as exemplified by the residue of the thymus gland at the age of sixteen or by disturbed ovarian function. Crocker<sup>47</sup> stated that keloids are "uncommon in puberty." The possible association of keloids with ovarian or gonadal disturbance has been stressed by some writers because of the "presence of keloids before puberty and their absence or spontaneous resolution afterwards and the same coincidence before and after the menopause."<sup>48</sup>

These statements are contradictory; the second half "the same coincidence before and after menopause" coincides while the first half conflicts with the views expressed

by us at the end of this chapter where we associate the growth of keloids with greater hormonal concentration. During puberty

hereditary influences on keloid formation is intimated by the many instances of familial occurrences that have been reported by

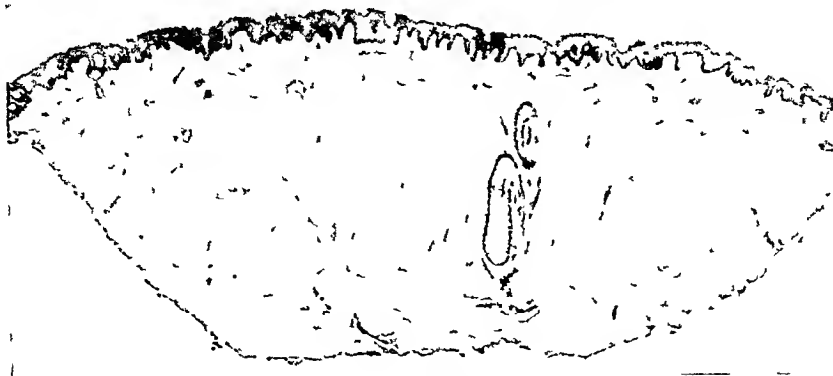


FIG 9

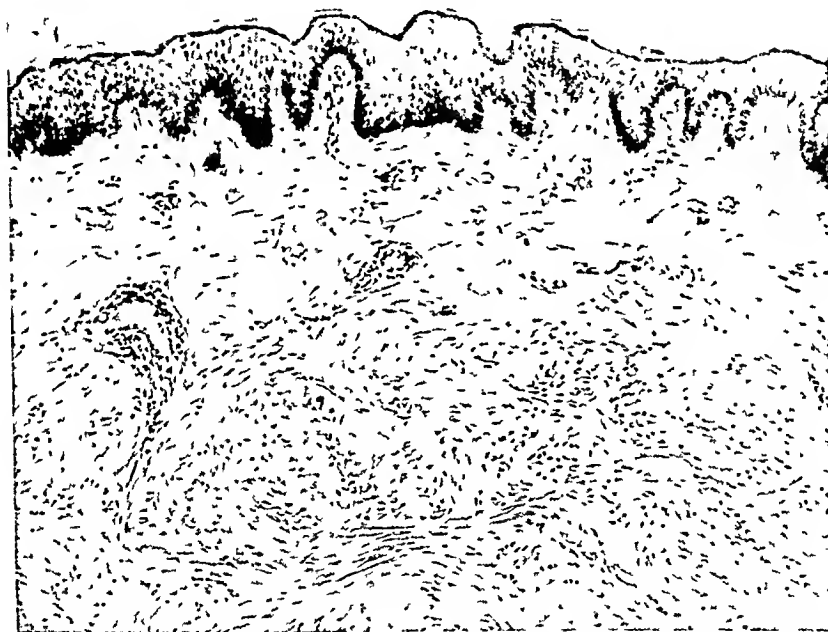


FIG. 10.

FIG 9. Microphotograph showing low power of a fairly young keloid, (hematoxylin and eosin  $\times 50$ ).

FIG. 10 High power of Figure 9 (hematoxylin and eosin  $\times 185$ ).

and adolescence, because of the increase of hormones, a larger number of patients should develop keloids. This actually corresponds with our findings that the greatest number of keloids, 34 per cent, occurred during the second decade.

The relation of keloid formation to the spleen is suggested by the disappearance of keloids after splenectomy in a case of splenomegaly.<sup>49</sup> This may be due indirectly to thyroid or other hormonal influences because of the well known interrelationship between the ductless glands. Familial and

Gate, Coste, Wilson, Hutchinson and other investigators as already cited, including our Case 54.

Darier<sup>50</sup> regarded keloids as tuberculids while others thought that they are caused by a nontuberculous virus.<sup>51</sup> Bazin<sup>52</sup> attributed them to a fibroplastic diathesis. Kahler<sup>53</sup> considered them as a trophoneurosis or disturbance of innervation. Pautrier<sup>54</sup> states that "we must assume the lack or excess of certain cellular ferments or substances which we are still unable to define." Dystrophy of the elastic and collagenic

plexuses of the skin have likewise been mentioned as causes of keloidal growths.

#### COMMENT

We are willing to subscribe to the theory of hormonal stimulation as being the main or the important contributing cause of keloid formation. The fact that the largest number (twenty-three out of sixty-seven patients whose ages were given, 34 per cent) occurred in the second decade and the large percentage, 12 per cent, of keloids that followed acne vulgaris lesions would point to a hormonal factor as a likely cause for keloids because of increased glandular stimulation in the young. This view is further supported by the spontaneous resolution or absence of keloids after the menopause and by the rarity of keloids in the aged, possibly due to the diminution or disappearance of the male or female sex hormones.

#### DIAGNOSIS

The diagnosis of keloid is easily derived at clinically by the usual history of an injury; by its shiny, smooth, taut surface; by its location in the longitudinal folds and above the level of the skin; by the frequent presence of gradually diminishing ramifications and by the hard consistency. Histologically, there is a dense and well defined connective tissue new growth limited to the corium. In early keloids a great number of connective tissue cells are present while in older growths the mass becomes more dense and the cells more sparse. The microphotographs illustrate clearly the histologic structure of a young and an old keloid. (Figs. 9, 10, 11 and 12.)

*Histologic Report of a Fairly Young Keloid of One Year's Duration* (Dr. Sachs). Extending from the upper part of the cutis down to the bottom of the section are bundles of fibrous connective tissue, in some areas loosely arranged, in other zones compact. These bundles appear to run in various directions. About the periphery of the mass is a moderate number of dilated blood vessels some of which are filled with

blood elements. There are a few dilated vessels within the connective tissue mass. The overlying epidermis is slightly acanthotic. The basal cell margin is intact and contains considerable pigment. The granular horny layer is present and apparently shows no change. There are no important changes in the rest of the epidermis.

Throughout the tumor mass is a moderate, diffuse, cellular infiltration. Most of the cells are large and spindle-shaped. They have a fairly large, vesicular, oval-shaped nuclei (fibroblasts). There is a slight amount of pigment in the upper cutis.

*Histologic Report of an Old Keloid of Several Years' Duration.* Extending throughout the entire cutis is a marked increase of connective tissue, the fibers being densely packed and arrayed in all directions. (Figs. 11 and 12.)

There are no adnexa in the section. In the upper part of the cutis there are a few small vessels which are moderately dilated. The epidermis is comparatively thin and other than a loss of rete pegs and papillary bodies shows no important change. Practically no cellular elements are present in the cutis. There are small fragments of elastic tissue throughout the entire mass.

#### DIFFERENTIAL DIAGNOSIS

While keloids have distinctive features and are usually easily recognized there are numerous instances in which a differential diagnosis has to be made between keloids and other raised nodular growths especially hypertrophic scars, sarcoids, scleroderma, fibroma and paraffinomas.

Both keloids and hypertrophic scars are due to trauma and both have their origin in the corium. Hypertrophic scars, however, do not extend beyond the original boundaries of injury, while keloids tend to extend into neighboring tissues usually forming claw or fringe-like projections. Hypertrophic scars are not usually elevated more than one-sixth of an inch (0.4 cm.) above the surrounding skin surface while keloids may reach the size of several inches. (Figs. 21 and 22.) In hypertrophic scars the

overlying epidermis is atrophic, the epidermodermal junction flattened and new collagen bundles are formed in the papillary

may undergo spontaneous healing, while keloids only rarely regress spontaneously.

The superficial sarcoids have a yellowish-

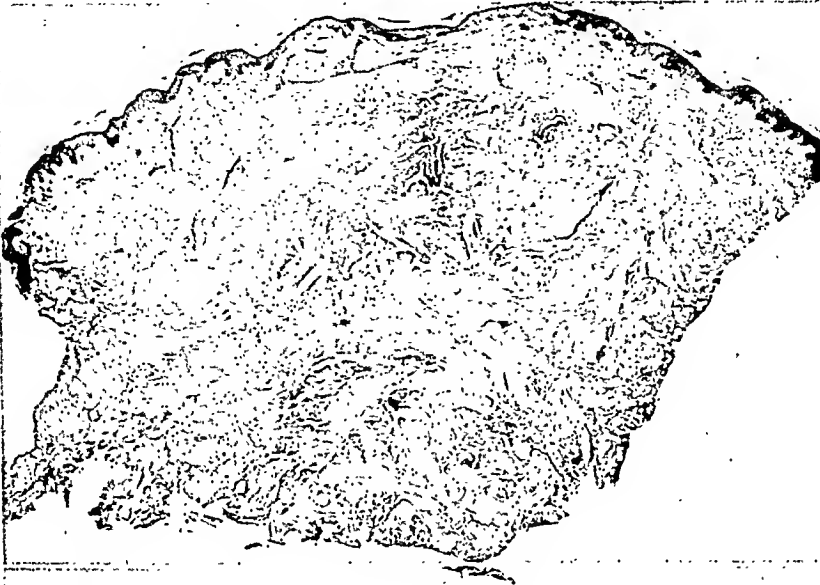


FIG. 11.

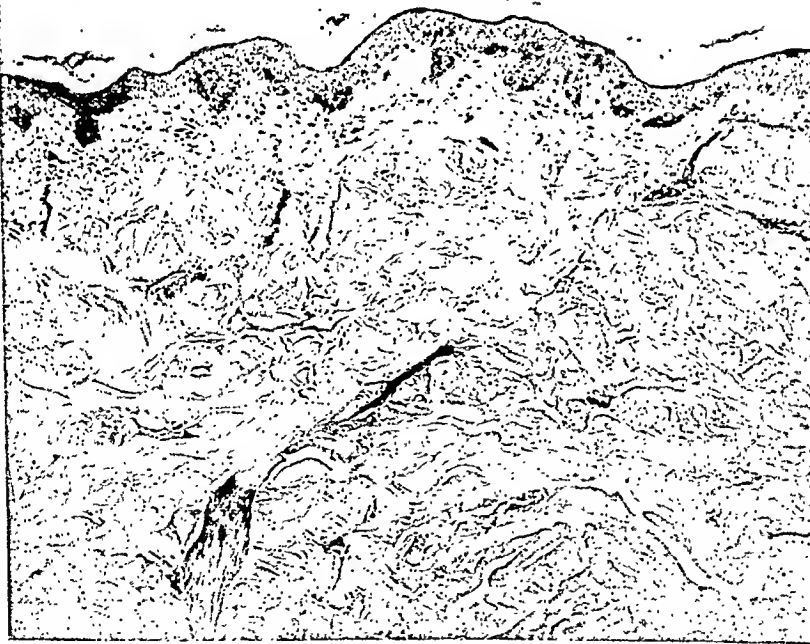


FIG. 12.

FIG. 11. Low power of an old keloid (hematoxylin and eosin  $\times 60$ ).

FIG. 12. High power of Figure 11 (hematoxylin and eosin  $\times 185$ ).

and subpapillary layers. In keloids the hypertrophic change begins in the middle of the corium and spreads slowly toward the surface, sparing the capillary layer and giving room to little if any appreciable changes in the epidermis.<sup>55</sup> Hypertrophic scars, especially those after burns, are much more transitory than keloids and

brown tinge. Sarcoids located on the face have a bluish center and a yellowish border. Diascopic pressure shows the nodules as grayish-yellowish foci. They are usually anergic to intracutaneous tuberculin injection. There may be lung, bone, eye and other tissue involvement. Histologically, the epithelioid and cell nests of the corium

separated by connective tissue septa are very characteristic. The elastic and collagen fibers are completely destroyed throughout the entire growth.

Scleroderma is markedly infiltrated and lardaceous. The center has the color of ivory. The border of a typical patch is distinctive. It is made up usually of a narrow zone consisting of a plexus of fine vessels which impart to it a pinkish-lilac or violaceous hue. Histologic examination reveals that the hardness is due to a thickening and increase in density of the collagen bundles and not to new formation of fibrous tissue. It shows an altered affinity for dyes as revealed by van Gieson preparations which stain sclerodermatous tissue reddish-brown while normal collagen stains red. The elastic tissue may be diminished but does not show the degenerative changes found in the atrophic diseases of the dermis.<sup>56</sup>

Fibroma durum occurs as a firm reddish nodule which may reach the diameter of 1 cm. They are usually located on the legs and may rise slightly above or be somewhat depressed below the general surface. Histologically, they are found to be composed of interlaced bundles of cellular fibrotic tissue separated from the overlying epidermis by a narrow margin. The collagen bundles have lost their normal form and arrangement and are rich in nuclei. They are narrower than normal and stain more deeply with eosin. The normal structures of the skin are usually entirely absent.

Paraffinomas occasionally resemble keloids, but their usual location on the face, their softer consistency and the history of previous paraffin injections serve to distinguish them from keloids. A histologic section would reveal the very typical swiss-cheese-like character of paraffinoma.

It is necessary to define the term cure as applied to keloids. Young and small keloids will disappear with a few subintensive, three-quarters of the erythema dose, (337 r for the 1 mm. and 412 r for the 3 mm. aluminum filter) x-ray exposures with little or no disfigurement but large and old

keloids will require numerous filtered roentgen treatments for their resolution. The cure in the latter will consist of a soft and pliable scar with some atrophy and, perhaps, some telangiectasia.

An x-ray unit with a mechanical rectifier was used in the clinic and a valve tube machine in our private offices. Since the erythema doses today are calculated in roentgen units, an exact administration of x-ray doses is everywhere assured. For unfiltered radiation the factors for the erythema dose were as follows: 100 kilovolts (6 inch spark gap), 3 milliamperes, 2 minutes, 8 inch distance from target to object. This equals 300 roentgens.<sup>57</sup> For filtered radiation through 1 mm. aluminum the factors were 137 kilovolts (9 inch spark gap), 5 milliamperes, 10 inch distance 3.75 minutes. This equals 450 roentgens. For filtered radiation through 3 mm. aluminum the same factors were used as for 1 mm. aluminum but for a period of 7.5 minutes. This corresponds to 550 roentgens.

#### SPECIAL CASES

A brief description of some of the interesting cases has already been given in this paper or included in the charts. The following five cases deserve special descriptions:

**SPECIAL CASE 1.** The most unusual case in our series is that of M. Z., aged sixteen, Case 75. (Figs. 13, 14, 15 and 16.) She registered at the skin department on October, 1935, with lesions on the face, neck, back and chest of four years' duration. There were numerous comedons, papules and pustules; also pea to coin-sized, discrete and confluent, smooth, shiny, well defined, hard growths, some assuming gyrate forms. On the surfaces of many of the keloids were numerous telangiectatic capillaries. She was treated prior to her admittance at the clinic with fifteen superficial x-ray exposures in 1934, 0.25 units each, without any result. The blood calcium was 10:1 mg. per 100 cc. of serum (normal 9.6-11.0). Old intracutaneous tuberculin test in concentration of 1:10,000 was negative. A roentgenogram showed a relatively small spherical heart and moderate cen-

No.	Name, Age, Sex, Race	Date of Admission	Duration	Cause	Description	Treatment Given	Result	Important Findings
2	T. E. 30 F. W.	5/11/31	Five years	Reeurred after ex-cision	Two cm. sized keloid on front of chest.	Keloid was exeised and subcutaneous dermal sutures used. The healed wound was then exposed to 6 genz rays 0.5 skin unit each. The keloid re-curred. Two x-rays skin unit 0.75 each filtered through 3 mm. aluminum were given once a month. (Total 825 r.)	Cured	Failure of subepidermal sutures and 3 units of grenz rays to prevent recurrence. Cured after filtered x-rays.
4	S. M. 11 F. W.	4/19/33	Two years	Dog bite cauterized with nitric acid	5 by 4 cm. linear keloid on upper arm.	Eight x-rays skin unit 0.75 each filtered through 3 mm. aluminum at first, then through 2 mm. aluminum every 4 weeks. (Total 3300 r.)	Cured	Cured after filtered x-rays.
5	C. F. 58 M. W.	10/ 2/31	Four months	Removal of senile keratosis	Finger nail-sized keloid on chest.	Four x-rays unfiltered skin units 0.5 each. (Total 600 r.)	No response	No response after 2 units of unfiltered x-rays even on young keloids.
7	G. L. 40 F. W.	11/30/33	Five years	Not stated	7.5 cm. keloid on right side of neck.	Three x-rays skin unit 0.75 each filtered through 1 mm. aluminum. (Total 1012½ r.)	Cured,	Cured after x-ray therapy.
8	F. J. 9 F. W.	10/ 7/32	Nine months	Scalded	Dollar-sized keloid on chest.	Eight x-rays skin unit 0.75 each filtered through 3 mm. aluminum. (Total 3300 r.)	Cured	Cured following filtered x-ray therapy.
10	R. R. 35 F. W.	9/23/33	Three years	Boils	Keloid on right shoulder.	Six x-ray skin unit 0.75 each filtered through 1 mm. aluminum once a month. (Total 2475 r.)	Cured	Cured after sufficient filtered x-ray therapy. Tuberculin test positive in dilution of 1:10,000.
12	G. F. 24 F. W.	3/26/31	Seven weeks	Followed acne cysts	Keloid on right cheek.	Destroyed by electrodesiccation, but it reeurred. Then 14 x-rays skin unit 0.25 each unfiltered were given once a month. (Total 1050 r.)	Slight improve-	Keloids followed acne cysts. It reeurred after electrodesiccation. It responded only slightly to unfiltered x-rays.
13	M. F. 11 M. W.	6/26/39	Two years	Post-operative	Post-operative in right inguinal region.	Four x-rays skin unit 1 each unfiltered were given once monthly (total 1200 r). There was no response. It was then destroyed by electrodesiccation but it reeurred. Four roentgen treatments 0.87 units each filtered through 1 mm. aluminum were given to umbilical and 5 such does to the inguinal region. (Total 1575 and 1969 r respectively.)	No response to 4 skin units of unfiltered x-rays. Cured with filtered radiation.	No response to 4 skin units of unfiltered x-rays. Cured with filtered radiation begun 20 days after electrodesiccation.

No.	Name, Age, Sex, Race	Date of admission	Duration	Cause	Description	Treatment Given	Result	Important Findings
14	L. A. 6 F. W.	12/ 4/33	Two years	Burn by fire	Multiple keloid on face, chest, neck and shoulders.	Seventeen x-rays unfiltered 0.25 skin unit each once weekly. (Total 1275 r.)	Very good result	Negative tuberculin tests in all concentrations. Reexamined on August 25, 1940, very good result.
18	N. E. 19 M. W.	11/10/31	One year	Followed electrodesiccation	Small pea-sized keloids over sternum.	Eight x-rays skin unit 0.75 each filtered through 3 mm. aluminum every 4-6 weeks. (Total 3300 r.)	Cured	Recurrence after electrodesiccation. Cured after sufficient filtered x-ray therapy.
19	B. M. 11 M. W.	8/ 8/31	One year	Burned	Palm-sized keloid over left pectoral area.	Three x-rays skin unit 0.75 each filtered through 3 mm. aluminum once monthly. (Total 1237½ r.)	Cured	Cured
20	C. J. 18 F. W.	7/14/28	Ten months	Fibroma molluscigurated followed by electrolysis to scar	Keloid on chin.	Three x-rays skin unit 0.75 each filtered through 3 mm. aluminum once monthly. (Total 1237½ r.)	Fair response	Keloids followed electrolysis treatment for scar. Fair response to filtered x-rays.
21	K. A. 30 F. W.	11/13/32	Six months	Excision of growth	Keloid on right wrist.	Fourteen x-rays skin unit 0.75 each unfiltered once weekly. (Total 1050 r.)	Poor response	Widening of scar even in clean wound.
23	M. L. 34 F. W.	6/20/32	One year	Pigmented nevus removed with acid	Two keloids 0.6 cm. each on left cheek.	Eight x-rays skin unit 0.75 each filtered through 3 mm. aluminum at first and then through 1 mm. aluminum. (Total 3637½ r.)	Cured	Cured after sufficient filtered x-ray therapy. Keloid followed treatment of nevus with acid.
24	D. R. 7 F. W.	1/13/32	Three years	Cause unknown	Two keloids 7.5 cm. and 3.1 cm. on left shoulder and arms.	Eight x-rays skin unit 0.75 each filtered through 3 mm. aluminum every 6 to 8 weeks. (Total 3300 r.)	Cured	Cured with filtered x-rays.
25	D. N. 34 M. W.	7/ 1/32	One year	Injury	Linear 6 by 4 cm. keloid on right cheek.	Seven x-rays exposures skin unit 0.5 each filtered through 3 mm. aluminum, last 2 treatments given through 1 mm. aluminum. (Total 2475 r.)	Slow response	Resistant to filtered x-ray therapy.
26	S. E. 16 M. W.	2/ 2/30	Three years	Acne vulgaris	Numerous pea and larger-sized round irregular keloids on chest.	Five grenz rays skin unit 0.5 each. Then 6 x-rays skin unit 0.75 each filtered through 3 mm. aluminum, followed by skin unit 0.5 through 3 mm. aluminum. (Total 2475 r.)	Cured	Keloid followed acne cysts. Five grenz rays skin unit 0.5 each failed to have any effect, but filtered x-rays resulted in cure.

No.	Name, Age, Sex, Race	Date of Admission	Duration	Cause	Description	Treatment Given	Result	Important Findings
31	F. F. 20 M. W.	10/24/31	Four months	Burn	Pea-sized raised hard growth on left arm.	Three x-rays skin unit 0.75 each filtered through 1 mm. aluminum once a month. (Total 1575 r.)	Cured	Keloid followed a verrucous lesion that was desiccated.
32	F. A. 42 F. W.	10/22/31	Six months	Small verrucous lesion desiccated	Three keloids on arm, axillae and breasts following scald.	Six x-rays skin unit 0.75 each unfiltered and 5 x-rays skin unit 0.75 each filtered through 3 mm. aluminum. (Total 2062 r.)	Cured	
33	K. I. 22 F. W.	12/30/28	Two years	Scalded	Two keloids 2.5 cm. and 1.5 cm. in size on chest.	Three grenz rays 0.5 units each every 2-4 weeks, no change. They were then exposed to x-rays skin unit 1 each, filtered through 3 mm. aluminum and 3 x-rays skin unit 1 each filtered through 3 mm. aluminum. (Total 6187½ r.)	Very resistant not much change	Keloid resistant both to grenz rays and to 6187 units of filtered roentgen rays.
34	Q. M. 18 M. W.	1/29/34	Three months	Cause unknown	Dime-sized keloid on chest.	Seven x-rays unfiltered skin unit 0.25 each (total 525 r). Then followed by 5 x-rays skin unit 0.75 each filtered through 3 mm. aluminum. (Total 2062 r.)	Cured	No change with unfiltered. Good progressive response with filtered x-rays. Keloid followed lesion of acne vulgaris.
35	M. B. 38 W. F.	10/27/33	Three months	Desiccation of basal cell epithelioma	One keloid on forehead.	Four x-rays unfiltered skin unit 0.5 each. (Total 600 r.)	Good response	Keloid followed electrodesiccation. Good response with 2 units of unfiltered x-rays.
41	W. M. 17 F. W.	8/ 9/31	Four months	Burn	One light keloid on cheek.	Ten x-rays unfiltered skin unit 0.5 each once every 2 weeks. (Total 1500 r.)	Cured	Cured with unfiltered x-rays because keloid was young.
42	V. M. 11 F. W.	9/15/31	Five months	Nevus unius lateralis desiccated	Quarter-sized keloid on side of neck.	Six x-rays skin unit 0.75 each filtered through 3 mm. aluminum every month. (Total 2475 r.)	Cured	Keloid followed electrodesiccation.
54	F. E. 17 F. W.	4/15/35	Two years			Six x-ray skin unit 0.75 each filtered through 3 mm. aluminum every 3 weeks. (Total 2475 r.)		Keloids followed electrolysis for removal of superfluous hair.

No.	Name, Age, Sex, Race	Date of Admission	Duration	Cause	Description	Treatment Given	Result	Important Findings
75	Z. M. 18 F. W.	10/ 2/35	Four years	Acne vulgaris	Multiple pea-to dime-sized and larger keloids on face, chest, neck and back.	Twelve x-rays skin unit 0.25 each unfiltered. (Total 900 r.)	No change	Negative to tuberculin in all concentrations. This is the most extensive case of keloids in our series. They did not respond to any form of therapy. (Special case I, Figs. 13, 14, 15 and 16.)
76	F. A. 40 F. W.		Three months	Flap for plastic operation	One linear keloid on left arm	Filtered x-rays.		Congenital syphilis. Keloid developed on arm from which flap was taken but not on the nose on which plastic operation was done. Case serves to illustrate regional susceptibility. (Figs. 6 and 7.)
80	J. C. 12 M. C.			Retro-auricular keloid followed cut by ax keloid on deltoid region followed vaccination	Large keloid behind right ear also on left deltoid region.			See description of special case III. Fifty per cent regression of large keloid on deltoid region within 3 years.

tral and slight interlobar, pleural thickening. An area on the right shoulder corresponding to the outline on the photograph (Fig. 16) was treated with the following methods without showing any improvement: Forty injections of fibrolysin intrakeloidally for a period of six months; negative and positive poles of a direct or galvanic machine using 1.5 milliamperes for 2 minutes, six treatments of each. One large keloid was treated with several through-and-through black sutures. Two small lesions were treated with four solid carbon dioxide snow applications. The patient also took thyroid extract orally 0.25 Gm. and thiosinamine, 0.1 Gm. each three times a day for six months. She kneaded the keloids frequently with cocoa butter.

**SPECIAL CASE II.** A. L., aged six, Case 14 (Figs. 17, 18, 19 and 20) registered at the skin clinic on December 4, 1935. She presented extensive keloids of two years' duration on the face, neck, chest, shoulders and upper extrem-

ities following severe burns in an explosion. She was treated with seventeen unfiltered x-rays, 0.25 units each, once weekly. Examination on January 30, 1942, showed that the keloidal growths on the face and nose were flattened and the skin was white in color. Those on the flexor surface of the neck were brownish-red, very pliable and did not interfere with the movements of the head. The keloids on the shoulders and extensor surfaces of the arms were decidedly improved. Considering the marked disfigurement which the patient presented when first seen, this should be considered a very good result.

**SPECIAL CASE III.** F. C., a nine year old colored boy, developed in 1934 a large keloid behind the left ear following a cut with an ax. A similar-sized keloid developed on the left deltoid region following a vaccination. Within a period of three years the retro-auricular growth was thrice excised by a surgeon but it recurred soon after. (Figs. 21 and 22.)

After the last excision the surgeon repaired the wound with a full thickness skin graft taken from the abdomen. The grafts failed to take and the keloids developed behind the ear and on the abdomen.

On December 17, 1937, the authors exposed the growths behind the left ear and on the abdomen to filtered x-rays, 200 r every four to eight weeks, receiving a total of about 5 units (200 r). After three months the keloids on the abdomen gradually began to regress and became soft, wrinkled and flat. Three months later the keloid behind the left ear began to undergo involution. The keloid on the left deltoid region which was not exposed to x-rays also became softer and shrank to one-half of its original size.

This is an example of the tendency of colored patients to have large keloids. It also illustrates the futility of surgical removal of a keloid unless it is followed by roentgen treatments at the first sign of recurrence.

The regression of the keloid on the left deltoid region may have been due to spontaneous resolution or to the indirect effect of the roentgen rays applied to the retro-auricular

eighteen, registered at the Skin and Cancer Unit on June 20, 1940. She had a triad complex of adenoma sebaceum, tuberosa sclerosis

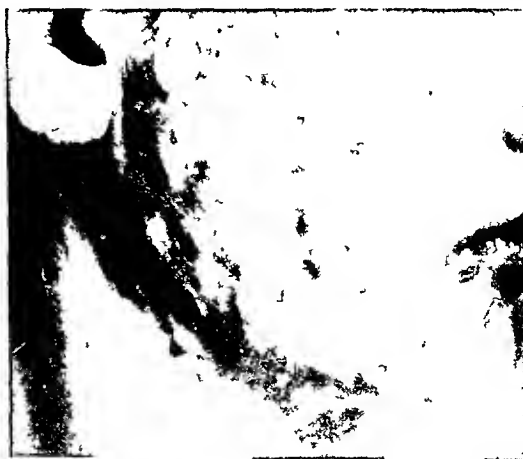


FIG. 13. Case 75. Special Case 1. Illustrating multiple keloids on face, chest and back in acne lesions.

and epileptiform seizures. She presented a large disfiguring growth on the scalp and a crimson-red eruption on the face. She had a flat purplish-red nevus on the scalp since birth. At nine years this nevus (flammeur?) began to



FIG. 14. Case 75. Special Case 1. Showing numerous keloids on front of chest and breasts.

region, similar to the result obtained by Niles<sup>58</sup> in acne vulgaris when in many patients the untreated side of the cheek cleared up as soon and as completely as the side that was treated with x-rays.

SPECIAL CASE IV. L. T.,<sup>58</sup> a girl aged

develop into a hard, painless growth. It continued to grow for seven years and then it became stationary. It was almost hairless, flesh-colored to reddish, 18.7 cm. in length, 2 cm. to 1 cm. in depth and 5-8.8 cm. in width. (Figs. 23 and 24.)

The entire growth was removed in two operations by Dr. Straatsma and a plastic repair done. The flaps were taken from the thigh and

back with hypertrophic scarring of the flexor surfaces of the thighs. On the right buttock were several punched-out, irregular ulcerations



FIG. 15. Case 75. Special Case 1. Illustrating the presence of hundreds of small keloids on the back of the chest.



FIG. 16. Case 75. Special Case 1. Illustrating a section of the back on which numerous methods of treatment were done including forty injections of fibrolysin without any benefit.

flank. A section examined by Dr. Rabson and Dr. Satenstein showed the histologic structure of keloid. Van Gieson stain failed to reveal any neural tissue.

**SPECIAL CASE v.** Mrs. M. J., a woman aged forty-nine, applied for treatment as a private

varying from 0.1 to 1 cm. in depth, 1 to 3 cm. in width and 5 to 10 cm. in length. The floors were fairly even, necrotic, secreting some slight seropurulent discharge. Some of the keloidal areas were covered with dry, dark brown, hard,



FIG. 17. Case 14. Special Case 11. Illustrating extensive keloidal scars and bands, interfering with the movements of the neck following burns in an explosion at eight years of age.

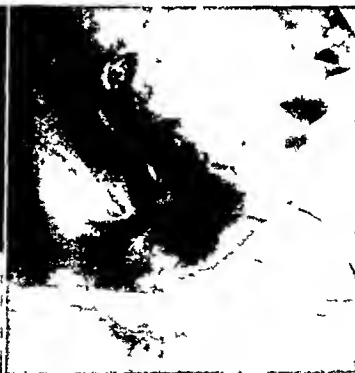


FIG. 18. Case 14. At eight years of age, showing large keloidal bands on the right side of the neck.

patient on March 1, 1942. She gave a history of having scalded her nates and thighs about fifteen years ago with hot water. Physical examination revealed extensive keloidal growths involving both buttocks and lower part of the

hyperkeratotic patches. Two sections taken from the latter were examined histologically by Dr. Satenstein and diagnosed as keloids. The epidermis was thickened and the horny layer increased. There was no evidence of any malignancy in the epidermis. The cutis showed an increase in the collagen bundles and fibroblasts.

## ANALYSIS OF THE CASES TREATED

We treated forty-six female and thirty-four male patients, three of which were

other to 5 units of unfiltered x-rays which were given soon after recurrence (Cases 37 and 41). Twenty patients were cured by



FIG. 19. Case 14. Showing the good result at the age of fourteen. These bands are soft and pliable.



FIG. 20. Case 14. At fourteen years of age. Keloidal scars are now pliable. She is able to move her head freely in all directions.\*

colored. They ranged in age from two to fifty-eight years. None of fifteen patients gave a personal history of tuberculosis. Intracutaneous tuberculin tests were made on nine patients. All of them gave a negative reaction to the tuberculin in concentration of 1:100,000, three of these giving 3 to 4 plus reactions to 1:10,000. The keloids were located mostly on the upper part of the body. They varied in color from yellowish-white to purplish-red and in duration from one month to many years. Nine cases followed lesions of acne vulgaris; eight, electrodesiccation, two cauterization with acids, and one after ultraviolet exposure. Two cases followed the piercing of the ear lobes for earrings (Figs. 4 and 5), and one case with multiple keloids on the chin followed electrolysis for hypertrichosis. All seven keloids that were excised recurred. There was a tendency to spontaneous resolution in three patients.

Only one of six patients showed some improvement after 4.5 units of infra-roentgen (grenz) rays. Three units of grenz rays failed to prevent recurrence in Case 2. One patient responded well to 4 and an-

other to 5 units of unfiltered x-rays which were given soon after recurrence (Cases 37 and 41). Twenty patients were cured by

filtered radiation. Two patients were very resistant to large doses of x-rays. One patient (Case 25) did not respond to 2475 and another (Case 33) to 6187 r units.

Keloids that were treated regularly soon after occurrence of recurrence responded well to comparatively small doses of x-rays.

One patient, special Case 1, did not show the slightest response to any form of treatment known to us.

## TREATMENT

Keloids have been treated with internal medications, topical applications, physiotherapeutic methods and surgical procedures. Iodine, mercury, arsenic, quinine, strychnine, potassium iodide and thio-sinamine have been used internally without any apparent benefit. Similarly useless are the various topical applications of which only the pepsin-boric acid method of Unna

\*The keloidal bands of the neck were excised at the New York Post-Graduate Hospital in September, 1942. We feel that the patient had probably already lost the keloidal tendency. She is being watched very carefully. X-ray treatments will be given at the first sign of recurrence of the keloids.

need be mentioned which had for its purpose the softening and reduction in the size of keloids through lengthy applica-

For large keloids and those that are resistant to a sufficient amount of filtered x-rays and radium, excision in the healthy



FIG. 21. Case 80. Special Case III. A large keloid developed behind the right ear following an ear cut.



FIG. 22. Case 80. Large keloid on left deltoid region followed vaccination. It recurred after excision. This keloid regressed 50 per cent without treatment during the age of twelve to fifteen years.

tions. The intrakeloidal injections of any water or oily solution are to be condemned as being painful and useless. Numerous injections of fibrolysin have been given in our special Case 75 and in our private practices without the slightest change.

The physiotherapeutic methods of cryotherapy (refrigeration), electrolysis with negative or positive poles, ultraviolet rays water-cooled (Kromayer) and grenz rays are useless. Iontophoresis with solutions of potassium iodide, sodium salicylate, resorcin in various dilutions as tried by us and on eight patients by Lerner<sup>59</sup> did not produce any beneficial results.

Among the surgical methods used but proved ineffective by the authors are scarification with the scalpel, capillary drainage by means of through-and-through keloidal sutures, and subepidermal excision for the purpose of causing primary union.

Roentgen rays and radium are the only effective treatments for keloids and will cure most of them except those that are radioresistant.

tissue by the scalpel or electrosurgical knife (acusection) is preferred. The healing should be promoted by aseptic technic and the use of stimulating substance such as scarlet red salve. Roentgen therapy should be applied at the first sign of recurrence, but not until then as irradiation before and soon after excision will not prevent the formation of keloids.<sup>60</sup>

Filtered roentgen therapy is the treatment of choice. The exact dose will depend upon the location, duration, thickness, size of the keloid and the age of the patient. For small keloids one-quarter of a skin unit weekly filtered through 1 mm. aluminum (112.5 r), or one-half unit (225 r) every two to three weeks may be given, the lesions being closely shielded with lead foil up to a total of 2 to 3 units (900–1350 r). For larger and thicker keloids one-half to three-quarters of a skin unit (subintensive) filtered through 3 mm. aluminum (275–412.50 r) should be given every three to four weeks. Six to eight such subintensive doses are usually necessary for a good re-

sult. Twelve such doses may be considered as the maximum that could be used but only in exceptional cases.

While it is generally recognized that young keloids respond better than old keloids to radiation it has been our experience that some young keloids will require even more roentgen treatments than older keloidal growths. This can be explained by the fact that in early keloids the stimuli which are responsible for their development are not sufficiently counteracted or suppressed by the average amount of roentgen ray treatments and a dosage of about 5 erythema doses is required for their cure.

Biokinetic massage and kneading with cocoa butter is a very useful procedure in conjunction with x-ray and radium treatments and is especially indicated for hard and extensive keloids that interfere with the motion of joints.

Radium is to be used for small keloids that are inaccessible to x-rays. Soft or beta radiations may be applied for fresh and superficial keloids and hard gamma rays for keloids that are more than 1 or 2 mm. in thickness. A half strength, glazed, flat applicator screened with 0.1 mm. aluminum and shielded with two layers of rubber tissue may be placed in contact with the superficial keloid for ten to twenty minutes depending upon the age of the patient and location of the lesion. This may be repeated once every four to six weeks for about six treatments.

For lesions above 1 or 2 mm. in thickness gamma rays are preferable. A half-strength flat applicator may be screened with 1 mm. of brass and 3 mm. of rubber and placed in contact with the lesion for eight to twelve hours, applied at one time or in several visits one to two hours a day. In some instances it is advisable to cross-fire with a combination of x-rays and radium. For example, in a deep-seated keloid in the cheek radium may be placed in the mouth and x-rays applied to the external surface of the cheek.<sup>61</sup>

Mention should be made here of the pre-

vention of keloids. Patients who are susceptible to keloidal growths should be advised to avoid irritation and trauma, such



FIG. 23. Special Case iv. Showing adenoma sebaceum of the Hallopeau Larrede type.

as sunburn, tight belts, etc. Special attention should be given to the treatment of acne, furunculosis, herpes zoster and other skin diseases that may result in keloid formation.

#### SUMMARY AND CONCLUSION

Most keloids are caused by a known trauma. Even spontaneous keloids are thought today to result from an injury which may have been so slight as to have been overlooked by the patient.

Our studies do not show that syphilis and tuberculosis are etiologic factors in the production of keloids. There was only one case of known syphilis in 248 patients from our series, from the Department of Dermatology of the Post-Graduate Medical School and Hospital and the Skin and Cancer Unit, and even that patient showed only regional predilection for keloids.

Special emphasis has been placed on the glands of internal secretion as possible factors in keloidal growth. The greater percentage of keloids (34 per cent) in the second decade of life, the larger number (12 per cent in our series) that follow acne vulgaris lesions and the rarity of keloids in the aged, perhaps as a result of spontaneous resolution due to diminution or absence of hormonal secretion, point to a hormonal factor as the possible cause of keloidal growths.

Hyperparathyroidism which causes hypercalcemia has been regarded as a factor in promoting keloidal growths by causing

better is the result, though some young keloids require even more roentgens than older keloids to effect a cure. A keloid of



FIG. 24. Special Case iv. Showing large keloidal growth on the scalp which was removed later by Dr. Straatsma in two operations, flaps being taken from the flank and the thigh. The result has been good.

an increased calcium content in the tissues. However, with special stains that break up the albuminoid molecule which is combined with the calcium it was found that there was an actual decrease of calcium in the tissues.

Epulis, some tumors of internal organs as in the throat, lung, stomach or ovaries, and even esthiomene and rectal strictures are looked upon by many investigators as forms of keloidal growths.

Although keloids have distinctive characteristics and are ordinarily easily diagnosed, there frequently arises the question of differentiating keloids from other growths and a resort to histologic section is obligatory.

Primary union of a growth does not prevent the formation of keloids. Treatment with roentgen rays or radium before or soon after excision of a keloidal growth does not prevent its recurrence.

The sooner the keloid is treated the

sufficient size should be first excised by the scalpel or surgical knife, the wound healing hastened and x-ray or radium applied at the first sign of recurrence.

Among the special cases described two patients are of particular interest: one a girl aged eighteen, with hundreds of keloids that did not respond to any form of therapy and another, a woman aged forty-nine, with extensive keloidal growths of fifteen years' duration who developed deep ulcers and hyperkeratotic areas.

Various treatments as medications *per oram*, intrakeloidal injections, physiotherapeutic and surgical methods have been mentioned to discard those proved worthless and to recommend those found to be of value.

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# TREATMENT OF BLOOD STREAM INFECTIONS WITH HEMO-IRRADIATION

## CASE REPORTS

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IN 1934, the June issue of Northwest Medicine contained an article by this writer and E. K. Knott, entitled "Irradiated Blood Transfusions in Treatment of Infections." Since that time, several articles have been published by various writers on research phases and clinical responses to this same treatment. This modality is generally spoken of as hemo-irradiation. It is the purpose of this paper to review briefly the widened rationale as well as to report further on the writer's experience with this therapy in the treatment of blood stream infections.

Hemo-irradiation therapy consists of exposing a part of the patient's blood to ultraviolet rays. A predetermined amount of the patient's blood is withdrawn from a vein and citrated. The blood is then strained into a transfusion graduate and returned to the same vein through an air tight conduit. A specially designed irradiation chamber with a quartz window is connected into the conduit. The chamber is about two inches in diameter and approximately one inch thick; it has an inlet and outlet, and connecting the two is a labyrinthine passage formed by baffle plates which are ground to fit flush against the quartz window so that the blood must flow around instead of across them. As the blood passes through the channels of this chamber it is exposed to ultraviolet rays generated by a water-cooled mercury vapor quartz burner. The distance from the source of the ultraviolet, or the burner, to the blood is approximately 3 cm. The period of time of exposure for each cc. of blood, the total volume of blood irradiated and the frequency of treatment are determined by the

pathological status and the patient's condition. The volume of blood irradiated at any one time is generally determined by the patient's weight and condition; usually about one-twelfth to one-sixteenth of the blood volume is treated.

There has been no basic change of procedure since 1933. Research, however, has brought about certain modifications of technic. The design of the irradiation chamber is greatly improved, giving a more uniform exposure to all parts of the blood. There has been developed an electrically synchronized irradiation machine that regulates exactly the rate of flow of the returning blood and the time of exposure.

Originally, hemo-irradiation was developed to try to utilize the bactericidal properties of ultraviolet rays by directly irradiating the blood stream and thereby combating blood stream infection. This idea was developed successfully, but clinical observations on patients treated indicated that several other biological and biochemical reactions were taking place within the patient with decidedly beneficial results ensuing. The reactions observed in various conditions have been subjected to critical investigation for several years.

This research in a wide variety of conditions, and the method of administering treatment developed by E. K. Knott have resulted in the procedure known as the Knott Technic. This technic of applying ultraviolet rays of selected wave lengths and intensity and the time of direct exposure of the blood for the treatment of infections gives us, I believe, a therapy of more pronounced merit than any other to date. It is essential, however, that for uniform

and satisfactory results, the Knott technic be strictly adhered to.

A rational foundation that led to the development of hemo-irradiation was established on published scientific data on the biological and biochemical reactions of ultraviolet irradiation. All of the points of the rationale are facts that have been substantiated by several recognized authorities working independently. Some of the most important underlying principles of this procedure are based on the fact that ultraviolet irradiation by selected wave lengths and correct exposure causes: (1) An inactivation of toxins and viruses;<sup>1,2</sup> (2) destruction and inhibition of growth of bacteria;<sup>3,4</sup> (3) increase in the oxygen combining power of the blood;<sup>5</sup> (4) activation of sterols resulting in production of vitamin D;<sup>6</sup> (5) increased cell permeability;<sup>7</sup> and (6) an absorption of ultraviolet by the blood and emanation of secondary radiations.<sup>8</sup>

There have been many demonstrations of the inactivation of toxins and viruses *in vitro* by ultraviolet rays. The work on snake venom by Noguchi<sup>10</sup> who inactivated the venom of cobra, rattlesnake and daboia is a good example. Macht<sup>1</sup> inactivated the toxins of pernicious anemia in human blood serum by short exposure to ultraviolet rays. Schubert<sup>11</sup> gives a report on work with tetanus toxin, and Hausmann, Neumann and Schubert<sup>12</sup> have a published report on work done with tuberculin.

The experimental work *in vivo* presents more difficulty in drawing accurate conclusions. In blood irradiation therapy, however, clinical evidence of inactivation of toxins within the patient is readily discernible. In cases of severe infections that recover, a marked diminution of toxic symptoms is noticed within twelve to forty-eight hours after treatment. Malaise, severe headache, nausea, mental confusion, chills, fever and other toxic symptoms are generally relieved. The temperature usually drops, as does the white cell count.

The blood sedimentation rate is generally decreased markedly. In the occasional case in which the temperature remains high

there will be observed a marked reduction in toxic symptoms. If this condition is accompanied by a reduction of the pulse rate to normal, it usually indicates some localized infection or abscess. However, the patient's condition has improved from the critical stage to a noncritical one. The reduction of toxic symptoms of the patient is one of the most important guides in determining if the treatment should be repeated.

The destruction or attenuation of bacteria is shown in the accompanying charts. The time of exposure necessary to kill different bacteria with ultraviolet rays under controlled conditions of wave-length, temperature and intensity has been found to vary. It has also been found that exposure insufficient to destroy bacteria in one medium may be sufficient to destroy them in a different medium. When a small part of the total infected blood stream is irradiated for a period of time less than required to kill bacteria in a different medium, a complete attenuation or destruction of bacteria is generally achieved. The blood specimens that developed profuse growth in cultures (e.g., *Streptococcus hemolyticus*) before irradiation showed no such growth within twenty-four to seventy-two hours after the first or second irradiation. It must be noted, however, that with certain pathological conditions more than two treatments may be necessary to achieve this result.

The bactericidal properties of ultraviolet energy are partially explained by the minuteness and by the chemical structure of bacteria—certain bacteria are destroyed by an amount of irradiation which merely stimulates normal body cells. There are two causes for this; first, body tissue cells are immense compared to bacteria cells, so that we might expect and actually do get different results when irradiation impinges upon them; second, there occur rather freely in certain bacteria two photosensitive amino acids—phenylalanin and tyrosin—which occur but slightly in body cells. These acids cause greater absorption of ultraviolet by the bacteria which brings about coagulative

or destructive changes in them, without lowering resistance of normal body cells which are not as photosensitive.

The Rockefeller Institute recently announced that they have found a more effective method of preparing vaccines, by using ultraviolet rays instead of heat to render the viruses nonvirulent. They are using this method to prepare *in vitro* vaccines for influenza and rabies. In hemo-irradiation on patients with blood stream infection, only a small portion of the patient's total volume of blood is treated. There is some reason to believe that by destroying the bacteria in the treated portion of the blood, an autogenous vaccine is produced which, coupled with the action of induced secondary irradiation causes destruction of the bacteria in the blood stream.

Induced secondary irradiation is a known physical phenomenon and easily demonstrated with human blood irradiated with ultraviolet. Hemoglobin absorbs radiation over a wide range of wave-lengths; in the ultraviolet region of the spectrum it absorbs strongly. Secondary irradiation can be readily demonstrated by placing irradiated blood in a thin-walled quartz vessel and setting it on an ultraviolet-sensitive film; the film will be fogged. This secondary irradiation probably accounts for some of the cumulative effects and remote results of hemo-irradiation. It can be shown clinically that certain effects which are observed shortly after treatment are increased for some period of time: a reduction of toxic manifestations in certain cases, a feeling of warmth in others, and a definite peripheral vasodilation in almost all.

Studies in oxygen absorption values of blood after hemo-irradiation were recently made by Miley.<sup>5</sup> Increased oxygen combining power of the blood is readily observed clinically. Patients who are cyanotic from the administration of sulfanilamide or other drugs, or from some pathological condition, usually have their cyanosis disappear within a few minutes after treatment. In pneumonia patients this is

particularly striking. Extreme cyanosis generally disappears within a few minutes.

We present here seven case histories; four histories of patients with hemolytic streptococcic septicemia, two histories of staphylococcic septicemia, and one history of colon bacillus septicemia. The colon bacillus septicemia was not treated by the writer but was the patient of another physician who used this treatment.

The writer was called in on two other cases of hemolytic streptococcic septicemia, but the patients were moribund and treatment did not help.

Five cases of *Streptococcus viridans* septicemia have been given hemo-irradiation. Three of these patients had advanced endocarditis when first treated and were only helped temporarily. The fourth had no detectable heart lesion and treatment was given in the early stages of the infection. The patient was irradiated in 1936 and returned to work six weeks later. He was last seen in 1941 and there has been no return of symptoms since 1936; he is apparently completely well today. The fifth patient had a well developed *Streptococcus viridans* septicemia, but also had no detectable heart involvement in 1938 when he was treated. He is still an invalid in 1941, invalidism being due to complicating influenzal meningitis and chest involvement. The patient apparently is progressing to recovery.

#### CASE REPORTS

CASE I. No. 30146. Mrs. G. G., thirty-seven years of age, was admitted to Virginia Mason Hospital, Seattle, Washington, on August 14, 1933, and gave the following history: Her last menstruation occurred on August 2. The usual signs of pregnancy were evident until September 30 when the normal menstrual flow started and continued until October 13 when severe hemorrhage occurred and she passed some membranes.

Physical examination revealed a firm but not tender uterus almost to the umbilicus; no fetal heart tones could be heard. There was a moderate amount of vaginal flow; temperature was 99°F., pulse 84, respirations 18. The tem-

perature remained practically normal until nine days after admission. The patient did not respond to pituitrin and hot packs.

ran a septic temperature despite transfusion, intravenous mercurachrome and iodine injections into the uterus, and she was critically ill.

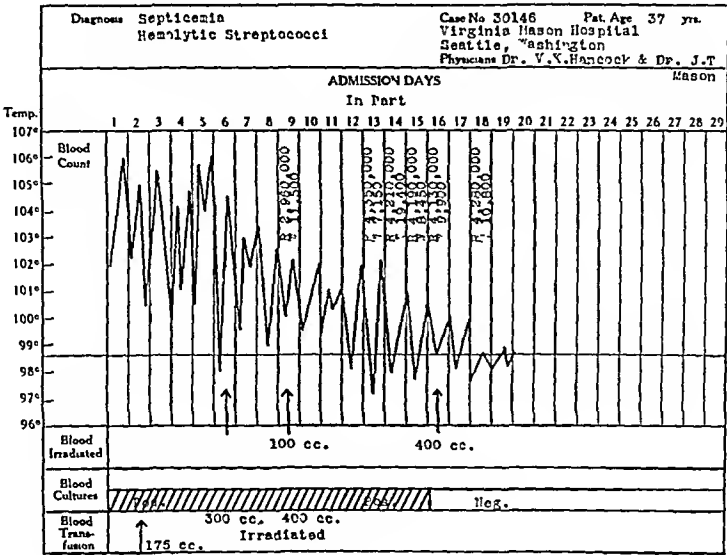


FIG. 1.

On October 24, dilatation of the cervix and induction of labor were advised. A small rectal tube was inserted at 10 A.M. and expelled in the afternoon with a small piece of placenta tissue the size of three fingers. On the following day a septic temperature began. Two days later a Bougie bag was inserted which was expelled later, producing but little dilatation. On October 28, the patient's temperature was 103.6°F., pulse 150 and respirations 20. Under ether anesthesia the cervix was dilated and it was found filled with multiple fibroids; there was a posterior cervical tear sufficient to insert one finger. With a sponge forceps in the uterus a pedunculated fibroid was lifted out and it was determined that the canal of the uterus was very torturous and filled with projecting fibroids. The cervical tear was repaired and two ounces of iodine were injected into the uterus at 5:40 P.M.

On October 29, the patient's temperature was 97.6°F., pulse 84 at 4 A.M. Temperatures averaged 105° to 106°F. for six days which was brought down each day by iodine injections into the uterus. A forty-eight hour blood culture showed Gram-positive bacteria, a few in chains, resembling streptococcus.

On November 8, this patient was irradiated and Figure 1 shows the course of this patient toward recovery once irradiation was started. From October 27 to November 8 this patient

On November 9, one day after the first hemo-irradiation, temperature peaks fell to 103°F. During the next three days peaks were 102° then 101°F. until November 20. After that the temperature fell to 99°F. where it remained until December 6. Peaks climbed again to 103°F., when menstruation started, and continued at that point until December 28 when it dropped to normal.

This patient gets considerable absorption from the uterus but blood cultures remain negative. It is planned to do a hysterectomy at the opportune time.

CASE 11. No. 53842. Mrs. B. W. was seen at her home September 28, 1938, suffering from typical renal colic pain in the left kidney and course of the left ureter. One-quarter gr. of morphine was administered which was repeated an hour and a half later. The pain subsided until 10:00 A.M. the following morning when it returned. The patient's temperature was 102.2°F and she was sent to the hospital. That night she had a chill and vomited.

There was swelling, extreme pain and tenderness around the left kidney. On the sixth day of admission, 25 gr. of sulfanilamide were given followed by 50 gr. on the seventh day. Due to added toxicity, a decrease in red cells and no apparent response, this treatment was discontinued. She had a chill each night until Octo-

ber 11 when the temperature rose to 108.4°F. (axilla).

At 3:00 P.M. the patient was irradiated and

and painful. The left cervical gland was less enlarged but some painful posterior auricular nodules were present. The right wrist was

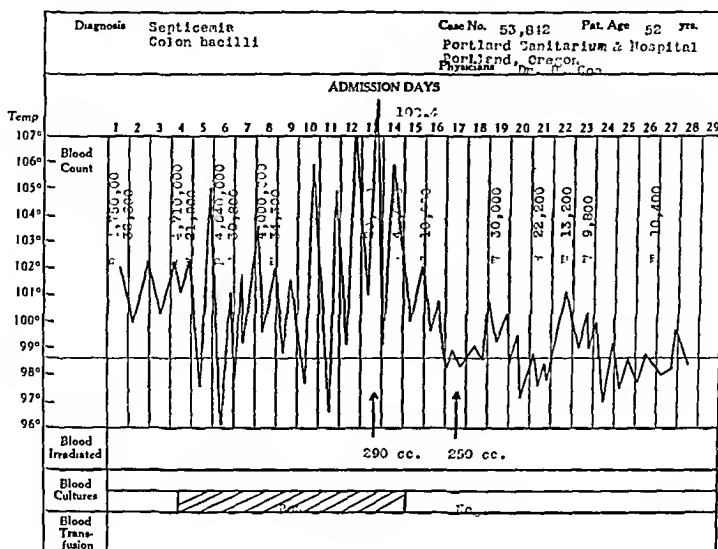


FIG. 2.

the temperature dropped steadily to 102°F. on October 13. Another irradiation was given on October 15 and the patient's temperature gradually returned to normal, averaging 99°F. She was discharged on October 26 and made a rapid and uneventful recovery. When last seen on March 1, 1940, the patient was enjoying normal health. (Fig. 2.)

The final diagnosis was pyelitis with colon bacilli septicemia.

CASE III. No. 10081. E. O'B., a female, fifteen years of age was admitted to Columbus Hospital, Seattle, Washington, on July 26, 1935, with a temperature of 103°F., and pulse 120.

Two weeks before admission she had a nasal discharge following diving and swimming. Five days before admission she had visited a doctor and upon returning home noticed a swelling of both jaw and neck on the right side. Four days later the same swelling appeared on the left side of the neck and jaw. The patient vomited after taking pills; she had chills, fever, malaise and general weakness. The pain in the back of the head recurred and there was some painful movement in fingers and wrists with swelling.

Physical examination revealed the posterior side of the pharynx well injected with dilation of the veins. There was a questionable piece of tonsil tissue present in the right fossa. The right cervical glands were swollen, tender, hot, red

somewhat painful and the left wrist was less painful. There was some evidence of heat and swelling in both wrists. The heart revealed a definite pulmonic murmur.

The patient had a septic temperature for twenty-one days ranging from 96° to 106.8°F. On the twenty-second day after admission this patient's blood was irradiated and from then on she progressed to an uneventful recovery. (Fig. 3.)

The diagnosis in this case was infectious pharyngitis with cervical adenitis; hemolytic streptococcic septicemia.

CASE IV. No. 11252. J. D., a male, twenty-two years of age was admitted to Columbus Hospital, Seattle, Washington, on January 6, 1936, with a temperature of 102°F. and a pulse of 70.

He had been hit by a car on December 26, 1935, and was found by the side of the road and taken to an Army Post Hospital where ten stitches were placed in a scalp wound on the right side. He stayed at that hospital overnight and was treated later at the doctor's office. The stitches were removed about January 1. He claimed that infection had set in and the scalp wound had become swollen with resultant closure of the right eye. Headaches persisted since the accident but no x-rays had been taken. Continual hot packs had reduced the swelling which became localized behind his right ear and

beneath the right cheek. On the day of admission he noticed the presence of a sore throat with tenderness over the right mastoid region. There was no complaint of pain in the ear.

and the cultures became negative within twenty-four hours after the second irradiation. From then on his recovery was uneventful. (Fig. 4.)

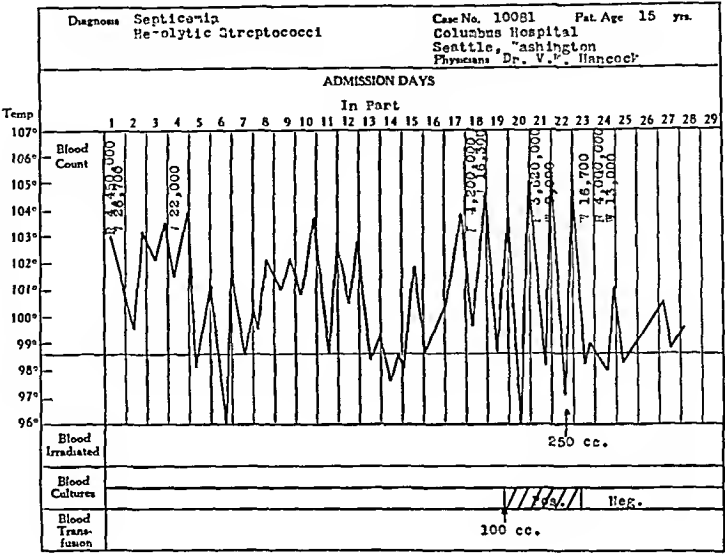


FIG. 3.

Physical examination revealed the patient to be fairly comfortable but the head was held in a fixed position. There was some fever and swelling of the right cervical glands. The scalp wound was indurated with some exudation.

The diagnosis in this case was cellulitis of the scalp wound and hemolytic streptococci septicemia.

CASE V. No. 38434. R. F. R., a female, twenty-one years of age, was admitted to

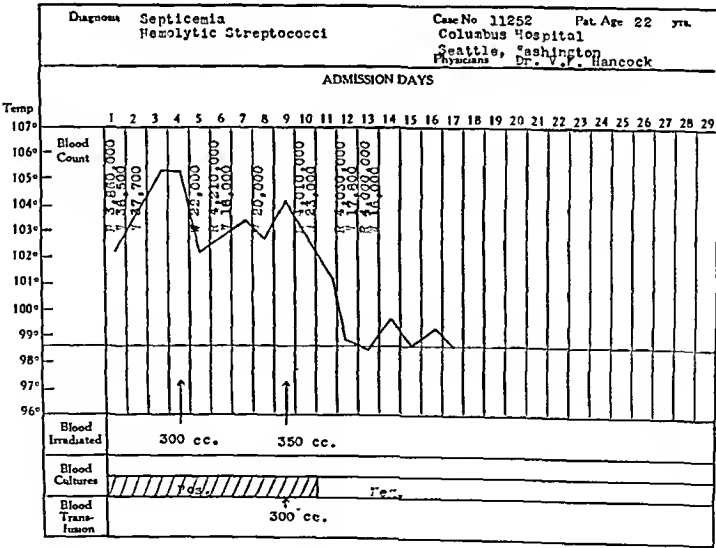


FIG. 4.

The genitourinary and gastrointestinal examinations were negative. The blood cultures were returned positive for hemolytic streptococcus.

This patient was given two blood irradiations

Virginia Mason Hospital, Seattle, Washington, on January 23, 1935, with a temperature of 102.2°F. She gave the history of accidental miscarriage twelve days previously of a two month pregnancy. There had been considerable

hemorrhage. The mass was removed from the cervix with forceps and irrigation was instituted. Three days later the patient had a chill, fever and bloody sputum.

The diagnosis in this case was postabortal septicemia, hemolytic streptococci and bacteriemia.

CASE VI. No. 33902. C. H. G., a male,

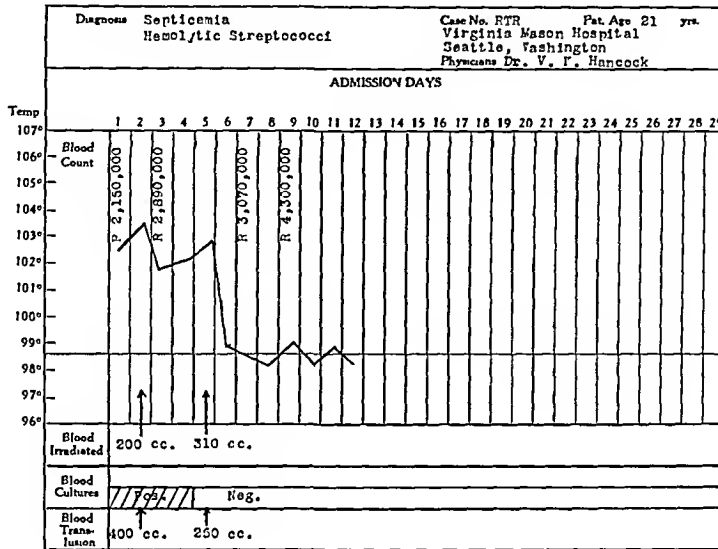


FIG. 5.

The physical examination revealed the patient to be very ill with a septic temperature of 103.6°F. Her pulse was rapid, the chest was negative and there was tenderness in the lower portion of the abdomen. Blood cultures were

forty-two years of age, was admitted to Virginia Mason Hospital, Seattle, Washington, on January 14, 1935, with a history of severe pain in the right leg. On January 22, there was swelling, local tenderness and signs of inflam-

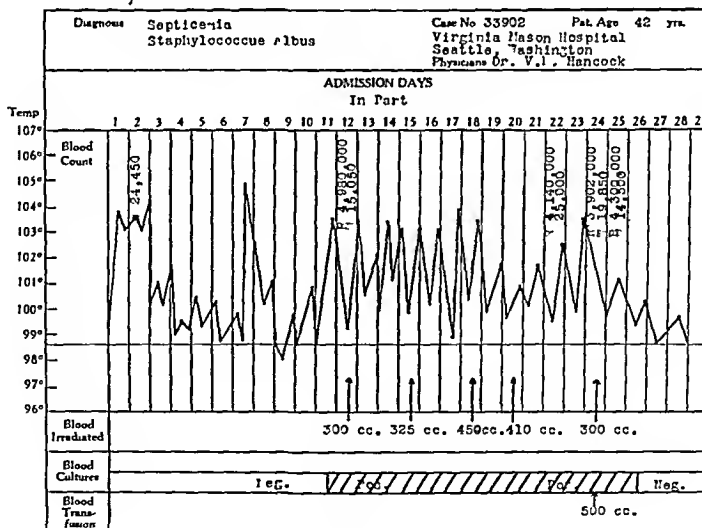


FIG. 6.

positive for hemolytic streptococci. Two irradiations were given this patient and her temperature dropped to 98.8°F. twenty-four hours after the second irradiation. From this point the patient had an uneventful recovery. (Fig. 5.)

mation of the lower part of the leg at the area of injection. There were no definite signs of localization. He had a septic temperature of 104°F. There was not much pain, no fluctuation and no indication for drainage.

On January 28, incision and drainage of abscess over the medial side of the knee joint were carried out. His temperature at that time

Hospital, Seattle, Washington, on June 3, 1934, with the following history: temperature, 104.2°F. There had been pain in the left leg four

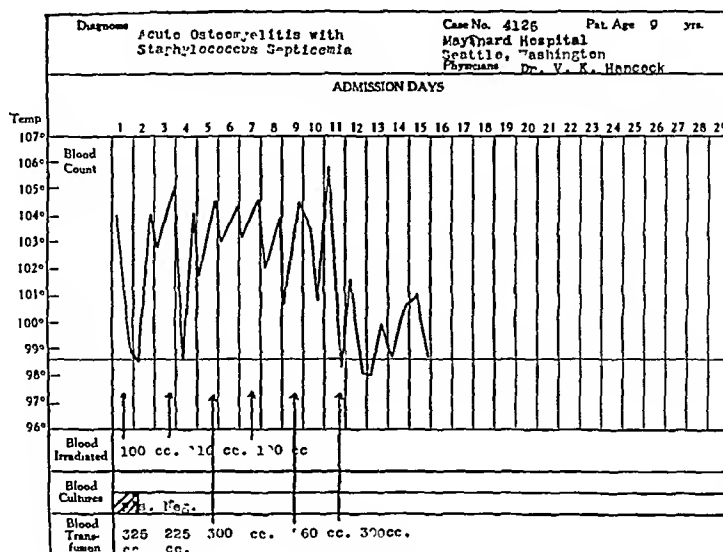


FIG. 7.

was 104.8°F. On February 1, it was decided to carry out further drainage. An incision was made in the mid thigh and some pus was encountered. Another incision was made just below the knee anteriorly and through-and-through penrose drains were inserted.

On February 4, the patient was definitely improved. The induration of the thigh had decreased, there was no fluctuation and he suffered very little pain. On that day the right inguinal lymph glands were enlarged, reddened, indurated and painful. On February 5, the glands in the right groin were swollen, painful and inflamed. Induration in the upper part of the thigh had decreased and the wound drained slightly. On this day a blood culture showed positive staphylococci (loaded).

On February 6, this patient was irradiated and this procedure was carried out a number of times until February 14. When the blood culture was taken on February 17 it was found to be negative. The patient was discharged on February 20 with the final diagnosis of varicose ulcer with infected right leg complicated by phlebitis of the right leg and thigh and staphylococcal septicemia. The patient recovered completely from septicemia and convalesced for six weeks before becoming actively engaged at his trade. (Fig. 6.)

CASE VII. No. 4126. C. C., a female, nine years of age, was admitted to the Maynard

days previously which was generalized at first and later localized in the left hip. There was no gross swelling in this area and no paralysis of the leg but the patient experienced a great deal of pain when moved.

The child appeared very ill and toxic; the tonsils were enlarged and reddened and the throat could not be well visualized. There was some thick mucopurulent discharged in the throat and marked tenderness and pain in the right thigh.

On June 3, x-ray was negative but clinical findings indicated acute osteomyelitis. A window was made in the left femur and irradiation was carried out. Blood culture was positive for staphylococcus. On the following day a window was made in the medial inferior end of the right tibia. A blood culture at that time was negative. On June 5, an x-ray revealed slight bronchitis or an early stage of bronchopneumonia. A second irradiation was carried out. On June 6, an opening was made into the left lateral posterior inferior femur extending into cancellous bone.

This patient had been given a number of irradiations plus donor blood transfusions. The diagnosis was acute osteomyelitis, bronchopneumonia and staphylococcal septicemia. This child had had three operations in four days. Two days after the first irradiation the blood stream was negative. She was discharged

in seventeen days and has followed the usual postoperative care and progress. (Fig. 7.)

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DENTAL operations involving the palate are best done with the patient under block anesthesia or infiltration anesthesia although the intratracheal method of administering an anesthetic agent by inhalation often may be used to advantage.

# PRIMARY BRAIN TUMOR\*

## FOLLOW-UP STUDY OF 179 CASES

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DR. HARVEY CUSHING stated in the introduction to his classical monograph<sup>1</sup> on intracranial tumors that "precise information in regard to what has happened to the survivors is more important than the mere statistical enumeration of the dead and living." This suggestion that the time had arrived for an assay of the value of surgery in the treatment of cerebral neoplasms has not been generally followed, although the notable contribution of Van Wagenen<sup>2</sup> disclosed most important information. Van Wagenen's study revealed for the first time not only the mortality statistics but a careful appraisal of the end results in terms of a useful and happy postoperative existence. The technical methods for the surgical attack have now been perfected. What we need to know is, what may the individual patient expect and hope for after the ordeal, and can prognosis be more definite?

With these thoughts in mind, the 179 cases of primary brain tumor seen at the Peter Bent Brigham Hospital between July 1, 1932, and June 1, 1941, have been carefully analyzed, and the information gathered from this study as a check-up on a representative group of brain tumor cases is presented here. No new methods of therapy are suggested, but this follow-up has laid emphasis on the end results as viewed by lay people whose desire for prognosis concerns the usefulness of the individual after therapy as well as the simple mortality rates. All patients except seven responded to follow-up letters or visited the follow-up clinic. No patients seen prior to July 1, 1932, were included since they are numbered in Dr. Cushing's series and have

been commented upon by others.<sup>2-5</sup> Of the 179 cases, 150 were verified by histologic study, and twenty-nine by ventriculography or pneumo-encephalography.

On the whole, the incidence of the various types of brain tumors in this series parallels that found by Cushing<sup>1</sup> in his report of 2,000 cases. (Table 1.) About one-half of our cases were gliomas, with pituitary tumors and meningiomas next in

TABLE 1

Type of Brain Tumor	No.	No.	Per Cent
Gliomas (varia)		89	49.7
Pituitary tumors		25	13.9
Chromophobe	17		
Acidophil	2		
Basophil	1		
Craniopharyngioma	5		
Meningiomas		19	10.6
Acoustic neuromas		7	3.9
Blood vessel tumors		4	2.2
Neuroblastomas		3	1.7
Lipoma		1	0.6
Chordoma		1	0.6
Melanosarcoma		1	0.6
Unclassified brain tumors		29	16.2
Total	.	179	100.0

frequency. The unclassified brain tumors, that is, those which were not verified histologically, made up 16.2 per cent of the total. The meningiomas, acoustic neuromas, pituitary adenomas, cystic gliomas, blood vessel tumors, and unclassified cysts, those types considered favorable by Horrax,<sup>6</sup> made up less than one-third of our series, whereas in the cases reported by Horrax<sup>6</sup> 54.5 per cent fell in this favorable group. This difference in favorable cases is

\* From the Surgical Clinic of the Peter Bent Brigham Hospital, Boston.

only the expected variation occurring in separate clinics and is largely a matter of fate.

A total of 251 operations, including burr holes, subtemporal decompressions, and osteoplastic bone flaps, was performed upon 166 patients. (Table II.) The case

tion and whom we have been able to follow, seventy-two are dead. Two lived for over seven years, but the majority of these patients died within one year of operation, in each instance the time of operation being the time of the initial diagnosis. When the gliomas are excluded, it should

TABLE II

	No. of Patients	Patients Operated Upon	No. of Operations	Postoperative Deaths	Case Mortality, Per Cent	Operative Mortality, Per Cent
Gliomas (varia)	89	87	141	27	31 0	19 1
Pituitary tumors	25	17	19	4	23 5	21 0
Meningiomas	19	19	27	5	26 3	18 5
Acoustic neuromas	7	7	10	1	14 2	10.0
Blood vessel tumors	4	4	6	0	0 0	0 0
Neuroblastomas	3	3	5	0	0 0	0 0
Lipoma	1	1	2	1	100 0	50 0
Chordoma	1	1	2	1	100 0	50 0
Melanosarcoma	1	1	1	0	0 0	0 0
Unclassified brain tumors	29	26	38	2	7 7	5 3
Totals	179	166	251	41	24 7	16 3

mortality was 24.7 per cent for the entire group. For the gliomas the case mortality was 31 per cent; for the meningiomas, 26.3 per cent; and for the pituitary tumors, 23.5 per cent. The total operative mortality was 16.3 per cent, being 21 per cent for pituitary tumors; 19.1 per cent for gliomas; and 18.5 per cent for meningiomas. These figures are high and demonstrate that a serious mortality is still to be expected following surgery for brain tumor. No attempt has been made to lower these figures by weeding out those who died of complications not directly related to the underlying disease or to the operation. It should be mentioned here that we have abandoned the more radical procedures in the treatment of pituitary adenomas and cerebellar medulloblastoma and are now treating these tumors with x-ray irradiation. The results of this form of therapy have been reported elsewhere,<sup>7,8</sup> and are more encouraging than the results following radical surgical treatment.

Of the 131 patients who survived opera-

tion and whom we have been able to follow, seventy-two are dead. Two lived for over seven years, but the majority of these patients died within one year of operation, in each instance the time of operation being the time of the initial diagnosis. When the gliomas are excluded, it should

be noted that there were comparatively few early deaths among those patients with the more favorable types of brain tumor, and that those suffering from meningiomas or acoustic neuromas had several years of useful life following operation. The results with the gliomas were the most discouraging, probably due to the fact that there was a high incidence of glioblastoma multiformi in our cases. (Table IV.) Two patients with glioblastoma multiformi survived for more than two years. These two patients were treated by decompression and biopsy, followed by radiation by x-ray in the same manner that we are now treating those with cerebellar medulloblastoma. We believe that this method of handling the rapidly growing gliomas will offer patients a more useful life for their remaining days. On the other hand, slow growing gliomas, such as the astrocytomas, can still be treated as focal lesions and an attempt can be made to remove them. Patients with cerebral medulloblastoma do not do well under any type of management;

although two patients are reported alive and well eight years after operation with cerebral medulloblastoma.

However, we believe that by intelligent use of decompression and biopsy followed by radiation therapy a better prognosis may

TABLE III

Type of Brain Tumor	Total No. of Patients Dead	Survival Period before Death									
		Postoperative Deaths	1-6 Mos.	6-12 Mos.	1-2 Yrs.	2-3 Yrs.	3-4 Yrs.	4-5 Yrs.	5-6 Yrs.	6-7 Yrs.	7-8 Yrs.
Gliomas (varia)	72	27	20	10	4	3	2	2	1	1	2
Pituitary tumors											
Chromophobe	3	3									
Acidophil	1							1			
Basophil	0										
Craniopharyngioma	2	1			1						
Meningiomas	11	5	2	1			1	2			
Acoustic neuromas	3	1	1				1				
Blood vessel tumors	1		1								
Neuroblastomas	2		1	1							
Lipoma	1	1									
Chordoma	1	1									
Melanosarcoma	1				1						
Unclassified brain tumors	15	2	5	4	4						
Totals	113	41	30	16	10	3	4	5	1	1	2

Gliomas, the most common brain tumors, include the most malignant intracranial tumors as well as the most benign. In any large series of brain tumors a considerable

be offered than by radical attempts to remove all of a rapidly growing glioma.

Fifty-nine (32.9 per cent) of the 179 patients are still alive. Careful follow-up

TABLE IV

Type of Glioma	Total No. of Patients Dead	Survival Period before Death									
		Postoperative Deaths	1-6 Mos.	6-12 Mos.	1-2 Yrs.	2-3 Yrs.	3-4 Yrs.	4-5 Yrs.	5-6 Yrs.	6-7 Yrs.	7-8 Yrs.
Glioblastoma multiformi	35	16	11	5	1	1	1				
Cerebellar medulloblastoma	11	1	2	1	1	2	1	1	1		1
Cerebral medulloblastoma	3	2		1							
Astrocytoma	17	5	7	2	2					1	
Oligodendroglioma	4	3						1			
Ependyoma	2	0		1							1
Totals	72	27	20	10	4	3	2	2	1	1	2

mortality will be encountered in the gliomas, and aside from radiation therapy in addition to surgery there is nothing to offer.

studies of recent date were obtained upon these survivors. (Table v.) A precise study of the condition of these patients shows

that eighteen (30.5 per cent) suffer serious handicaps or are so badly crippled that they cannot lead useful lives. This means that 30.5 per cent of the survivors present major problems to their families for their care, and except among the well-to-do, this is a great burden. However, lest it be said that pessimism is paramount, 41 (69.5 per cent) of the surviving patients are leading useful lives, although to be sure most of

of a group of intracranial tumors, both dead and alive at the present time.

## COMMENT

As stated in this report, little attention has been directed toward the end results following operation for brain tumor. Most reports have dwelt upon mortality statistics, operative technic, and more recently upon favorable types of brain tumors.

TABLE V

Type of Brain Tumor	Total No. of Patients Alive	Survival Period of Patients Still Alive*									Number Crippled
		1-6 Mos	6-12 Mos.	1-2 Yrs.	2-3 Yrs.	3-4 Yrs	4-5 Yrs.	5-6 Yrs.	6-7 Yrs.	7-8 Yrs	
Glioblastoma multiforme	4	3	1								2
Cerebellar medulloblastoma	2				1				1		2
Cerebral medulloblastoma	2									2	0
Astrocytoma	5			2			1			2	2
Oligodendroglioma	2			2							1
Ependymoma	0										
Pituitary tumors chromophobe	13	1	1			1	1	2	2	5	2
Acidophil	1									1	
Basophil	1								1		1
Cranopharyngioma	3			1				1	1		1
Meningioma	8				1	2	1		3	1	0
Acoustic neuroma	4				1		1	2			1
Blood vessel tumors	2					2					1
Neuroblastoma	1			1							0
Lipoma.	0										
Chordoma	0										
Melanosarcoma	0										
Unclassified brain tumors	11	3	1		2	1	1		1	2	5
Totals	59	7	3	6	5	6	5	5	9	13	18

\* No follow-up obtainable upon seven patients, excluded from this group

these survivors fall into the class of so-called favorable brain tumors. This parallels Horrax's figure of 70 per cent useful survivals in a larger series of favorable brain tumors.

It must be pointed out that in Table v there are ten patients living less than one year after operation or radiation therapy. It is not intended that these cases should give a false idea of survival, for some of them, especially among the gliomas, may not survive another six months or one year. However, as in the rest of this report, these tables are included to give a candid analysis

There are, however, in every group of patients with brain tumor who survive operation, a number who are so handicapped or crippled that they are completely dependent upon others. It is not in apology for those handicapped that this report has been made, but rather it has been our purpose to point out that these patients do exist. The cause of these handicaps is, of course, due to the underlying nature of brain tumors, but may occasionally be due to well intended but ill advised attempts at surgical removal of the lesion. It is difficult to analyze just when surgery

has been carried too far. We believe that brave attempts to excise irremovable brain tumors should be abandoned for decompression and biopsy followed by radiation therapy. This is not a defeatist attitude, because we agree with Sachs<sup>10</sup> and others that an intracranial neoplasm should be regarded as a focal disease and as such treated by removal. Nevertheless, removal in many instances is not feasible, and much damage may be done in the surrounding areas while the natural course of the tumor is unaffected or even accelerated.

It may be stated fairly that in certain favorable types of brain tumor a good prognosis can be offered the patient. However, even in these instances there is still a relatively high operative mortality, and misconceptions may easily arise concerning the prognosis unless the entire picture is kept in mind, especially among those surgeons who deal only occasionally with brain tumors.

#### SUMMARY AND CONCLUSIONS

1. One hundred seventy-nine cases of primary brain tumor seen at the Peter Bent Brigham Hospital, Boston, between 1932 and 1941 are reviewed.
2. The gross case mortality was 24.7 per cent and the gross operative mortality was 16.3 per cent.
3. Seventy-two patients survived from a few months to eight years, but the majority lived less than two years.
4. Fifty-nine (32.9 per cent) of the total series are alive at the present time.
5. Eighteen (30.5 per cent) of the living

patients are seriously crippled, while the remaining 41 (69.5 per cent) are leading normal lives.

6. Surgery upon brain tumors is still associated with a high mortality and a poor prognosis except for tumors which can be removed locally or which are sensitive to radiation therapy.

7. In giving prognosis, the surgeon must keep in mind both the pathological types of brain tumor and the possible crippling due to neighborhood injury if he is to give a fair appraisal.

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# A COMPARATIVE STUDY OF LOCAL BURN TREATMENTS\*

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FROM October, 1939, to date we have made a comparative study of four different local preparations for burns, choosing what we believed to be the two best "leatherizing" agents and the two best "nonleatherizing" agents. Although realizing that in major burns the topical application is of decidedly secondary importance to correct principles of treatment, such as asepsis, plasma therapy, nursing care, early skin grafting, etc., we wished to determine which agent, if any, proved the most efficient for use in a large charity hospital with inadequate nursing care and lacking in ideal facilities for treating burns. Such a comparative study seemed the more important since the great majority of reports in the literature upon the local treatment of burns deal with one favorite routine and lack any sort of control.

Since various writers differ somewhat in their gradation of the depth of burns, it is to be understood that in this paper "third degree" connotes full thickness destruction of the skin and its appendages. "Second degree," indicate by blister formation, is of intermediate depth between first degree erythema and third degree.

The present series consists of 199 burns in 192 hospitalized patients. Seven bilaterally similar burns were dressed with a different agent on either side. One hundred patients were treated with "Foille," fifty-four with tannic acid or tannic acid and silver nitrate, thirty with sulfadiazine and eleven with cod liver oil. Several additional patients were excluded from this series because they left too early for an evaluation of their treatment, and four patients with 80, 85, 85 and 100 per cent of body surface involvement were excluded as moribund. Practically all the cases in this

series were followed closely by the writer from start to final healing.

## METHOD OF TREATMENT

*Measures Common to All.* All burns, irrespective of their therapeutic group, received as nearly as possible the same general treatment. Unfortunately, the plasma given was seldom the calculated ideal and at times it was grossly insufficient, due to the inadequate supply in the blood bank.

All burns, with the exception of a few desperate cases, in which débridement was omitted, received the same initial local treatment, namely, heavy morphine analgesia and a fairly thorough débridement in the treatment room, employing white soap and sterile water, sterile gloves and instruments. In all more recent cases the attendants have masked.

The late management of third degree burns presented one common objective regardless of the local treatment used, namely, the early-as-possible removal of sloughing corium. About the end of the second week, when the necrotic corium began to separate, periodic tub baths or sterile saline compresses were instituted for mechanical cleansing, and from time to time all detachable corium (and eschar, if present) was gently dissected away with sterile instruments. Foille and cod liver oil dressings were continued on their respective burns right up until time for skin grafting. However, as soon as an appreciable amount of eschar had been removed from the leatherized burns, cod liver oil dressings were applied to the tanned burns and to a few of the sulfadiazine-sprayed burns. The majority of the latter were dressed with sulfadiazine or sulfanilamide ointment.

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All granulating surfaces were covered with Reverdin skin grafts as soon as the last of the necrotic corium was removed and, if possible, before the granulations became well developed.

#### DISCUSSION OF AGENTS USED

*Foille*\* is a thick, soapy, water-in-oil emulsion of mildly antiseptic value. Its use in the treatment of burns has been reported by Terrel,<sup>1</sup> Noland,<sup>2</sup> Galt,<sup>3</sup> Hamilton<sup>4,5</sup> and others. It contains:

1. A base of corn oil
2. Sulfhydryl radical..... traces
3. Calcium thiosulfate..... 0.03%
4. Sulfur..... 0.17%
5. Calcium oleate..... 0.36%
6. Oxyquinoline base..... 0.18%
7. Benzocaine..... 1.26%
8. Iodides (calcium and potassium)..... 0.40%
9. Phenol..... approx. 1.96%

When applied locally with a spray gun or camel's hair brush, *Foille* at first appears as a thick, transparent film, but slowly it forms with protein exudates a soft, brownish curdy precipitate. This is easily removed by soaking or sponging. The *Foille* routine has been described elsewhere.<sup>4,5</sup> Recently, we have begun to apply to the deeper and more extensive lesions an inner layer of several thicknesses of *Foille*-saturated gauze, and over this a thick, sterile compression dressing of gauze and cellucotton, the whole to be left undisturbed for ten to fourteen days. (Fig. 1.) Allen and Koch<sup>6</sup> and Siler<sup>7</sup> have emphasized the fact that compression dressings reduce the exudation of plasma into the burned area. After the removal of this initial compression dressing, the burn is kept constantly moistened with the agent and left exposed to the air beneath a cradle. We have treated a few of our most recent

burns with a modification of *Foille*, in which the oxyquinoline has been replaced by 1.5 per cent sulfathiazole. This, com-



FIG. 1. Illustrating a compression *Foille* dressing upon an extensive second degree burn of the left thigh and leg.

bined with the initial compression dressing, appears promising.

The detergent quality of *Foille* offers important possibilities in modern oil-stained warfare. It will readily dissolve grease and oil as shown in Figure 2, and in burns thus contaminated the patient need not be submitted to the degree of cleansing usually required before the application of one of the other agents. The *Foille* dressing will at the same time protect the burn and remove the remaining oil.

*Cod Liver Oil or Ointment.* The local application of this vitamin oil, introduced originally by Lohr,<sup>8,9</sup> has recently been used by Hardin,<sup>10</sup> Steel<sup>11</sup> and others. We have employed both the oil and the vitamin ointment with petrolatum base and have followed a routine nearly identical with that used for *Foille*. Thus far we

\* Dr. David E. Levin, technical director of the Carbimulphoil Company (producers of *Foille*) states that the original ingredients: corn oil, calcium hydroxide, sulfur, phenol and iodine are first emulsified together and later the oxyquinoline and benzocaine are added. The tabulation above is the chemical analysis of the finished product rather than a "shotgun prescription."

have confined its use to less severe, smaller burns.

*Tannic Acid with and without Silver*

of our cases within twenty-four hours, a few between the thirty-sixth and forty-eighth hour. One patient with 35 per cent



FIG. 2. A, feet covered with heavy, sticky oil, B, the same feet. The right foot has been cleaned for eighty seconds with Foille and the left for fifty-five seconds with gasoline.

*Nitrate.* Davidson's<sup>12</sup> tannic acid treatment for burns is doubtless still the most popular of all methods and needs no further description. In many of the cases in this group we used the combined tannic acid and silver nitrate method of Bettman<sup>13</sup> to hasten eschar formation. In the larger burns, the initial débridement was carried out with the patient totally immersed in a tannic acid bath, as described by Wells.<sup>14</sup> The warm solution greatly relieved suffering and, at the same time, diminished the tendency toward shock.

*Sulfadiazine.\** The application of 3 per cent sulfadiazine in 8 per cent triethanolamine to burns was introduced by Pickrell<sup>15</sup> in 1941. Adams and Crawford<sup>16</sup> also used this sulfonamide on fifty burns. We followed Pickrell's technic with the exception of not omitting the initial soap and water cleansing. Usually about four days were required to complete eschar formation. Folds subject to maceration and surfaces of necessity lain upon, frequently failed to form an eschar. Also, the sulfadiazine eschar was quite prone to crack and allow exudation and crustation. The sulfadiazine blood level reached its peak in the majority

of the body surface involved reached a peak of 12.8 mg. per cent in thirty-six hours; another with 28 per cent of surface involved reached a peak of 32.5 mg per cent in thirty-six hours; and a third with 65 per cent of her body surface burned showed a level of 25 mg. per cent in twenty-four hours. These figures show the need of following closely the blood levels of the drug in extensive burns.

Recently, we have begun to use a 1.5 per cent solution of sulfadiazine in triethanolamine to which 1.67 per cent methocel was added to make a faster drying film. With this preparation an eschar forms in about thirty hours, as compared to the ninety-six hours required by the original solution. However, the eschar itself is a cellodion-like film that adheres rather poorly and cracks and melts in places. It is, therefore, less satisfactory, we believe, than the original.

#### MORTALITY AND SURVIVAL

Thirty-eight of the 192 patients in this series died, a mortality of 19.8 per cent. Some slight excuse can be made for this appalling figure. The nursing care was inadequate, there were no facilities for

\* Supplied us by the Lederle Laboratories.

TABLE I  
ANALYSIS OF FATAL CASES

Name	Age	Per Cent Body Surface Burned				Agent	Time of Death (d. day) (h. hour)	Inadequacy of Plasma Therapy†	Remarks
		1st	2nd	3rd	Total				
H. L.	42	0	13	5	18	Foille	9th d.	Adequate	Cause of death uncertain
S. B.	24	5	17	17	39	"	16th d.	Marked	Cause of death toxemia and pneumonia
M. M.*	44	0	45	0	45	"	4th d.	Marked	Advanced hepatic cirrhosis. Smoke inhalation
W. H.	4	4	9	13	26	"	26th d.	Adequate	Overwhelming sepsis
B. H.	7 mo.	0	25	3	28	"	14th h.	Moderate	Death due to burn shock
C. D.*	62	0	4	6	10	"	44th d.	Adequate	Marked obesity. Diabetes. Arteriosclerosis
C. J.	71	1	5	2	8	"	17th d.	Adequate	Arteriosclerosis and hypertension
E. D.	72	0	2	9	11	"	55th d.	Adequate	Arteriosclerosis. Burn 4 days old and grossly infected at entry
W. P.	52	0	10	20	30	"	8th d.	Moderate	Became delirious. Temp. up to 105°F.
J. C.	34	0	9	7	16	"	41st d.	Adequate	Chronic alcoholism. Uremia; pneumonia
E. I.*	24	0	12	2	14	"	36th h.	Moderate	Cause of death uncertain
R. U.	4	10	25	20	55	"	4th d.	Adequate	Cause of death burn shock; pneumonia
E. W.	67	0	20	20	40	"	2nd d.	Marked	Hypertensive heart disease
T. H.	63	0	5	10	15	"	22nd d.	Adequate	Hypertensive heart disease; auric. fibrillation
D. M.*	13	0	20	40	60	"	33rd d.	Adequate	Death due to hepatic failure
P. P.*	58	0	3	15	18	"	25th d.	Adequate	Hypertension; arteriosclerosis; cerebral accident
E. J.*	71	0	11	11	22	"	26th h.	Adequate	Arteriosclerotic heart disease
M. H.*	11	0	17	9	26	Foille & Tan	3rd d.	Marked	Death apparently due to burn shock
S. F.*	29	0	9	0	9	"	8th d.	Adequate	Cause of death uncertain. History of pellagra
G. S.*	4 mo.	0	13	2	15	Tan	12th h.	Moderate	Cause of death uncertain. Possibly shock
G. Q.	1	0	16	0	16	"	16th d.	Moderate	Died following hematemesis
M. B.	2	1	56	0	57	"	7th h.	Marked	Death apparently due to burn shock
H. R.	19	3	13	0	16	"	3rd d.	Adequate	Cause of death uncertain
M. F.	65	0	11	0	11	"	21st d.	Adequate	Obesity; burn infected at entry
D. P.	25	2	43	20	65	"	6th d.	Marked	Death due to shock and toxemia
L. B.	61	0	8	0	8	"	27th d.	Adequate	Obesity; death sudden; question of coronary
J. W.	1	0	29	0	29	"	16th h.	Moderate	Sudden death; cause doubtless shock
T. O.	25	0	30	0	30	"	4th d.	Marked	Hematemesis
M. L.	58	0	36	9	45	"	21st h.	Marked	Death due to burn shock
S. H.*	2	4	50	0	54	"	2nd d.	Adequate	Death from shock despite adequate plasma
M. C.	45	0	16	26	42	"	31st d.	Adequate	Obesity; sepsis and exhaustion
E. W.	87	0	13	4	17	Sulfa.	42nd d.	Adequate	Hypertension; senility; pneumonia
E. B.	72	0	8	7	15	"	39th d.	Adequate	Hypertension; arteriosclerosis
G. B.*	22	0	34	30	64	"	4th d.	Marked	Aneuria; blood sulfadiazine level 28.8 mg. %
M. Mc.*	80	0	29	2	31	"	5th d.	Adequate	Arteriosclerosis; smoke inhalation
G. P.	22	2	10	23	35	"	24th d.	Adequate	Became badly infected
C. O.	5	0	11	14	25	"	24th h.	Adequate	Death from shock despite adequate plasma
S. D.	1	2	5	0	7	C.L.O.	3rd d.	Adequate	Fulminating pneumonia

\* Autopsied case.

† Expressed as:—"adequate," "moderate" (inadequacy) and "marked" (inadequacy).

isolation and few for special care of burns. the extremes of age or were suffering serious organic disease.  
As will be seen from the mortality analysis  
(Table I) the amount of available plasm The findings of Dr. A. J. Miller of the

TABLE II  
ANALYSIS OF FINDINGS IN TWELVE AUTOPSIES

Name	Age	Time of Death	Per Cent Area Involved	Agent	Kidneys	Adrenals	Liver	Other Findings
R. P.	58	25 d.	18	Foille	Marked congestion; slight cloudy swelling	Not remarkable	Slight fat infiltration; moderate acute congestion; marked hemosiderosis	Bronchiectasis and bronchopneumonia; coronary sclerosis
D. M.	13	33 d.	60	"	Moderate congestion; slight cloudy swelling	Moderate congestion	Marked fat infiltration; also vacuolar degeneration of cells; slight early focal necrosis	Small epicardial hemorrhage; slight early bronchopneumonia
C. D.	62	43 d.	10	"	Not remarkable	Marked cortical hyperplasia and focal degeneration	Marked fat infiltration; also vacuolar degeneration of cells; slight early focal necrosis	Patchy myocardial fibrosis; basilar congestion of lungs
E. I.	24	24 h.	14	"	Not remarkable	Focal degeneration and hemorrhage of cortex	Very slight fat infiltration; slight central atrophy	Heart and lungs negative
M. M.	44	96 h.	40	"	Severe cloudy swelling; "toxic nephrosis;" old arteriosclerotic infarcts	Not remarkable	Marked old portal cirrhosis; only slight fat infiltration and no necrosis of regenerated lobules	Tracheobronchitis from smoke inhalation; heart negative
E. J.	71	31 h.	22	"	Severe cloudy swelling; "toxic nephrosis;"	Congestion and focal hemorrhage	Slight old portal cirrhosis; slight fat infiltration; little recent damage	Marked pulmonary congestion and edema and early patchy pneumonia; severe myocardial fibrosis
S. F.	29	7 d.	9	Foille and tan.	Arteriosclerotic changes; marked cloudy swelling; "toxic nephrosis;"	Congestion; focal lipoidosis of cortex	Marked cloudy swelling of liver cells as from some toxin; no fat infiltration	Lungs and heart not remarkable
M. H.	11	60 h.	26	"	Moderate acute congestion	Moderate congestion and focal hemorrhages	Marked atrophy and early patchy necrosis; very slight fat infiltration; hemosiderosis	Intense pulmonary congestion and edema; heart not remarkable
M. L.	58	32 h.	45	Tan	Not remarkable	Moderate congestion	Marked fat infiltration; early slight focal necrosis	Intense pulmonary congestion and edema; heart not remarkable
G. S.	4 mo.	21 h.	15	"	Moderate congestion; a few red cells in glomerular spaces	Not remarkable	Slight fat infiltration and slight degeneration of cells	Moderate congestion and hemorrhage into pulmonary alveoli; some epicardial and myocardial hemorrhages
S. H.	2	24 h.	50	"	Not remarkable	Intense congestion and focal cortical hemorrhages	Marked hydrops and edema of cells; no fat infiltration or necrosis	Intense congestion and some hemorrhages into pulmonary alveoli; heart not remarkable; marked hyperplasia of thymus and lymph-nodes
M. Me.	76	5 d.	31	Sulfa.	Severe cloudy swelling; "toxic nephrosis;" arteriosclerosis	Not remarkable	Slight chronic passive congestion; marked hemosiderosis; no necrosis of cells	Marked tracheobronchitis from smoke inhalation; myocardial fibrosis

and blood was seriously inadequate in ten cases and moderately so in six cases. Six burns involved 50 per cent of total body surface and a number of patients were in

Department of Pathology in the 12 autopsied cases are given in Table II. Generalized congestion of viscera, especially of lungs, gut, adrenals and spleen, such as described

by Moon<sup>17</sup> in animals dying of traumatic shock was found to a varying degree in patients dying in the first three or four days. This was particularly marked in M. H., M. L., G. S., and S. H., who had been grossly undertreated with plasma and blood.

The liver was the organ most frequently and seriously deranged, although not so constantly or specifically as Wilson and co-workers,<sup>18</sup> and McClure<sup>19</sup> found in their autopsies. Fatty infiltration, the commonest finding, occurred both early and late. Varying degrees of cell atrophy and degeneration and one instance of acute hydrops were found. There was no instance of well developed central necrosis nor of eosinophile infiltration. Liver damage was as pronounced in patients treated with Foille as in those treated with tannic acid, which is not in accord with the suspicion<sup>20,21</sup> that the latter is responsible for liver necrosis in burns. In short, our cases reveal no characteristic liver lesion; nor can it be predicted from the severity of the burn, from the application used, or from the time of death, just what the liver will show. Possibly in these few cases the variation in amount of plasma therapy has distorted the picture as iodine therapy has done in the case of hyperplastic goiter.

The adrenals showed variations in degree of congestion up to the point of scattered hemorrhages into the inner cortex. Usually the more marked reaction accompanied the severe burns with early termination. Lipoid changes were also found in some of the cortical cells. The kidneys for the most part manifested differing degrees of congestion. Three patients, two treated with Foille and one with sulfadiazine, showed enough cloudy swelling of the tubules to be called "toxic necrosis." There was marked hyperplasia of the thymus and lymph-nodes in one two-year old baby (S. H.) dying in twenty-four hours. The remaining organs were, on the whole, noncontributory to the general picture.

The mortality of the four therapeutic groups is shown in Table III. In such a small

TABLE III  
MORTALITY BY THERAPEUTIC GROUPS

Agent	Total Cases	Mortality, Per Cent	No. Cases with Over 50% Surface Involvement	Revised Mortality, Per Cent
Foille.	95*	17.8	2	16.1
Tan	52*	23.1	3	18.2
Sulfa	27	22.2	1	19.2
C. L. O	11	9.0	0	9.0

\* Two burns dressed conjointly with Foille and tannic acid are not included in this tabulation.

series, mortality figures of themselves mean very little, but analyses have been made of some of the important factors. The area of third degree involvement and also of combined second and third degree is averaged for the fatal cases of the four groups in Table IV.

TABLE IV  
AVERAGE AREA (IN PER CENT OF BODY SURFACE) OF COMBINED 2ND AND 3RD DEGREE BURNS AND OF 3RD DEGREE ALONE AMONG FATAL CASES

Agent	Fatal Cases	Per Cent Combined 2nd and 3rd Degree	Per Cent 3rd Degree
Foille	17	26.3	11.6
Tan	12	31.7	4.8
Sulfa	6	30.3	13.3
C. L. O	1	7.0	0.0

Various factors unfavorable to survival occurring in the different therapeutic

TABLE V  
INCIDENCE OF FACTORS UNFAVORABLE TO SURVIVAL

Agent	Total Cases	Age Under 2 or Over 60	Coincidental Debilitating Disease	Marked Obesity	Degree of Insufficiency of Plasma or Blood	
					Mod-erate	Mark-ed
Foille	95	18	9	1	4	3
Tan	52	10	0	4	3	4
Sulfa	27	7	5	0	0	1
C. L. O	11	4	0	0	0	0

groups are set forth in Table v. In Table vi the burns are classified according to the extent of the combined second and third degree involvement. The mortality associated with these varying-sized areas is also shown.

Third degree burns of 10 per cent or more of the body surface are extremely grave. In the present series the following third degree burns of this magnitude survived: *Foille*: 16, 14, 11 and 10 per cent. The average healing time was 120 days.

TABLE VI

PARTITION OF THE THERAPEUTIC GROUPS AS TO EXTENT OF INVOLVEMENT\* AND RELATED MORTALITY

Agent	Total Cases	Under 10% Body Surface Involved		10%–15% Body Surface Involved		16%–20% Body Surface Involved		21%–25% Body Surface Involved		Over 25% Body Surface Involved	
		No Cases	Mortality Per Cent	No. Cases	Mortality Per Cent	No. Cases	Mortality Per Cent	No. Cases	Mortality Per Cent	No. Cases	Mortality Per Cent
<i>Foille</i>	95	57	1 8	18	27 8	5	40 0	5	40 0	10	70 0
Tan	52	34	2 9	8	25 0	3	66 6	0		7	100 0
Sulfa	27	18	0 0	2	50 0	1	100 0	2	50 0	4	75 0
C. L. O	11	9	11 1	1	0 0	0		0		0	

\* This includes 2nd and 3rd degree burn and is exclusive of 1st degree burn.

A different approach to the problem of mortality is the consideration of the largest surviving burns of each group. There were no survivals in our series with combined second and third degree involvement in excess of 31 per cent of the body surface. The largest surviving second and third degree burns of each series with their healing times are as follows:

Type of Treatment	Combined Second and Third Degree, Per Cent	Third Degree, Per Cent	Healing Time in Days
<i>Foille</i>	22	7	155
<i>Foille</i>	22	16	80
<i>Foille</i>	24	10	146
<i>Foille</i>	27	14	186*
<i>Foille</i>	30	0 5	56
<i>Foille</i>	31	5	98
Tannic Acid	21	2	54
Sulfadiazine.	24	10	135
Sulfadiazine.	26	5	110

\* Patient left hospital with a small granulating pocket in the left axilla, kept open by a severe contracture.

*Tannic acid*: 12 per cent. Healing was complete in 150 days. *Sulfadiazine*: 11 and 10 per cent. The average healing time was 146 days.

From these mortality and survival analyses *Foille*, tannic acid and sulfadiazine seem about equally effective in the saving of life. The burns treated with cod liver oil are too few and too small to enter into this evaluation. Our mortality figure for the patients treated with sulfadiazine (22 per cent) corresponds closely to the 20 per cent mortality of Adams and Crawford<sup>16</sup> in their series of fifty cases.

*Foille* has been criticized on the grounds of the possible toxicity of its phenol content (1.96 per cent). Our clinical impression, as well as the mortality and survival statistics, do not substantiate this criticism. Even one of our fatal cases speaks well for *Foille*:

D. M., a thirteen-year old girl with nearly 60 per cent of body surface involvement (20 per cent second degree and 40 per cent third degree) lived for thirty-three days. This is the longest survival that we have ever observed

in a burn of this size and severity. Autopsy revealed a large fat-infiltrated liver compatible with chronic sepsis. The kidneys were remarkable only for terminal "cloudy swelling," and failed to show the nephritis that marks chronic phenol poisoning. The other organs were not remarkable.

PROGRESS AND HEALING

Nearly all these cases were personally followed by the writer to final healing. If a patient left the ward too early in his course, so as to leave an undue balance of his healing to Out-Patient Clinic or home, he was discarded from the comparative series.

precipitate which is readily wiped away with moist, sterile pledgets or washed off in a tub. With the entire lesion thus exposed for inspection, the trimming away of the softened necrotic corium, where it begins to loosen, is facilitated and pus pockets are easily found and unroofed. This "open" type of treatment is especially applicable to burns of the face, hands, genitalia and joint creases where a constricting indurated eschar is particularly objectionable. Also, burns eighteen hours and older, already potentially infected, should not, we believe, be sealed up with an eschar. In this connection it was observed by Koch<sup>22</sup> that in the

TABLE VII

AVERAGE NUMBER OF DAYS UNTIL 3RD DEGREE BURNS SURGICALLY CLEAN AND UNTIL ALL BURNS HEALED

Agent	3rd Degree Burns Surgically Clean		All 2nd Degree Burns Healed		Heavy 2nd Degree Burns Healed		3rd Degree Burns Healed	
	Cases	Days	Cases	Days	Cases	Days	Cases	Days
Foille.....	33	24.0	38	24.3	30	26.9	44	64.0
Tan.....	12	26.3	26	21.7	17	24.8	15	85.0
Sulfa.....	16	25.1	7	19.0	5	24.4	17	74.7
C. L. O.....	3	19.3	6	22.2	5	20.8	4	65.0

Table VII presents two endpoints: (1) days elapsed until the third degree lesions become "surgically clean" or, in other words, free of slough and fit for pin-point grafting, and (2) days elapsed until final healing of the burns grouped according to their depth.

*The Sloughing Stage of Third Degree Burns.* It had been our clinical impression that burns treated with Foille rid themselves of slough sooner than those dressed with other agents. The figures (Table VII) do not support this to a significant degree. However, the sloughing period in burns treated with Foille can be more efficiently and easily managed and with less pain to the patient than is the case with leatherized burns. At the daily toilette of the burn there is no adherent dressing or tough eschar to be removed; only the soft curdy

French and Belgian hospitals during the present war, burns over twelve hours old and those received at the front were treated by the Lohr cod liver oil method. It would seem from what has been said that the Foille routine would serve even better than vitamin oils, since in addition to being a bland ointment, Foille is more antiseptic, especially the modified preparation containing 1.5 per cent sulfathiazole.

*Final Healing.* It will be seen in Table VII that there was a significant reduction of healing time in the third degree burns treated with Foille over those treated by tanning or by the sulfanilamide spray. This superiority is especially important since the healing of third degree lesions of any size is the most difficult problem of burn treatment. Whether the cod liver oil therapy was as efficient as it appeared can

only be judged by a larger series involving more serious burns. The average area of third degree involvement of patients followed to healing is indicated below:

	Per Cent of Body Surface
Foille.....	1.6
Tannic acid.....	1.0
Sulfadiazine.....	1.8
Cod liver oil.....	1.1

Healing of second degree burns came slightly earlier among the leatherized burns than among those treated with Foille. However, these superficial lesions heal satisfactorily regardless of the local application.

An analysis of the incidence of factors unfavorable to healing occurring within the different groups is shown in Table VIII. The

TABLE VIII  
FACTORS UNFAVORABLE TO HEALING

Agent	Total Cases	Unfavorable Anatomical Location or Poor Co-operation of Patient		Burns 18 Hours Old or Older. Potentially Infected	
		Cases	Per Cent	Cases	Per Cent
Foille.....	100	10	10.0	18	18.0
Tan.....	54	8	14.8	6	11.1
Sulfa.....	30	2	6.7	3	10.0
C. L. O.....	11	0	....	0	

first heading includes burns handicapped in healing either by their unfavorable location or because the patient persistently traumatized or soiled them. Burns untreated for eighteen hours or longer were most often placed on Foille therapy, since this agent seemed naturally adapted as a dressing for infected or potentially infected lesions.

*Bilaterally-Treated Burns.* Seven patients with bilaterally comparable burns were treated simultaneously with two agents, one on either side. Two of these, M. H. and S. F. died (Table I) and will not be considered here. The other five are summarized in Table IX. The first four

cases were pin-point grafted. The sulfadiazine-dressed side of S. L., (Fig. 3) in spite of its slower healing, had received one more grafting than the Foille side. It is to be noted that V. M. developed a 10 per cent flexion contracture of the knee on the side that had been tanned. Foille, on the whole, appeared superior to the control agent in these few cases.

*Temperature Reaction.* In Figure 4 the average highest daily temperature and pulse for the first twenty days have been charted for all second and third degree burns involving 5 per cent or more of the body surface. The burns treated with Foille seemed to show significantly higher temperature reaction than did the other groups during the first eight to ten days. This is difficult to explain. It is apparently not on an infectious basis since the temperature curve made a rapid climb during the second and third days and was on the decline after the fourth day. The Foille pulse curve coincided more nearly with those of the other groups. Since the mortality and survival figures for patients treated with Foille compare favorably with those of the other groups, this early febrile reaction apparently does not bespeak serious morbidity or prognosis.

*Delirium.* Instances of delirium or mental disturbance were found only among those patients treated with Foille or sulfadiazine. There were thirteen cases in the Foille group (13.7 per cent) and four cases among the sulfadiazine patients (14.8 per cent). One patient treated with both Foille and sulfadiazine was irrational. Two of the Foille cases were delirious within the first three days, the remainder anywhere from the fifth to thirty-sixth days. Three of the sulfadiazine cases fell within the first two days, the fourth on the sixth day. The temperature in nine cases from both groups ranged from 103° to 106°F.; however, in six it did not exceed 101°F. The blood level of one of the patients treated with sulfadiazine was 30 to 31 mg. per cent of the drug during her delirium, but she recovered. The blood level in the others was below 10 mg. per

cent. The mortality of these delirious patients of both groups was 66.6 per cent.

**Bacteriology.** Routine cultures were taken one or more times (exclusive of the initial one) in 108 cases and the important organisms are set forth in Table x. Staphylococcus aureus was found alone slightly more often than in combination with

with Foille and tannic acid. In short, sulfadiazine seemed to be somewhat more bactericidal than any of the other agents, at least for Streptococcus hemolyticus.

**Pain Control.** Evaluation of the different agents in respect to their relief of pain during the early days of the burn (Table xi) revealed no outstanding difference

TABLE IX  
BURNS BILATERALLY TREATED WITH TWO AGENTS

Agent	Name	Age	Degree of Burn and Per Cent Surface Involved	Area Involved	Days Till Ready to Graft	Days Till Healed	Healing and Remarks
Foille	V. M.	13	6% 2nd 2% 3rd	Back of left thigh and leg	?	190	The Foille side was well in the lead when pustules developed on both sides; flexion contracture 10° on tan side
Tan	"	"	" " " "	Back of right thigh and leg	?	179	
Foille	H. C.	5	3% 2nd	Right foot and ankle		18	At discharge a few small crusts on both sides; still some tenderness and induration on tanned side
Tan	"	"	1½% 2nd	Left foot and ankle		18	
Foille	S. L.	58	8% 3rd	Left thigh and buttock	30	101	At final healing, slightly more tightness in gluteal region on Foille side, but the involvement had been slightly more extensive
Sulfa	"	"	6% 3rd	Right thigh and buttock	35	111	
Foille	M. M.	31	3% 2nd 1% 3rd	Right thigh and groin	13	43	Good healing on both sides, but more active on Foille side
Sulfa	"	"	7% 2nd 1% 3rd	Left thigh, abdomen and breast	17	68	
Foille	S. C.	2	2½% 2nd	Right buttock		17	The two burns were identical; progress and final healing were identical
Sulfa	"	"	2½% 2nd	Left buttock		17	

Streptococcus hemolyticus. The latter was recovered alone in but one instance. Although these routine cultures, streaked out on blood agar, were neither entirely accurate nor representative of all the organisms present, nevertheless it is doubtless significant that 70 per cent of burns treated with sulfadiazine were free of streptococci, whereas a much lower percentage were streptococcus-free in the burns treated

between them, although the tannic acid was somewhat superior in this respect and cod liver oil somewhat inferior. The initial application of tannic acid and silver nitrate, however, may be extremely painful. Patients frequently complained to a varying extent of burning for five or ten minutes after each sulfadiazine spray during the first forty-eight hours. It is our clinical impression that the sloughing stage was

definitely less painful for patients dressed with Foille than for those otherwise treated. The soft, curdy Foille coating was readily

obtained with the Foille treatment of severe burns of the hands and face. In general, however, the type of healing and

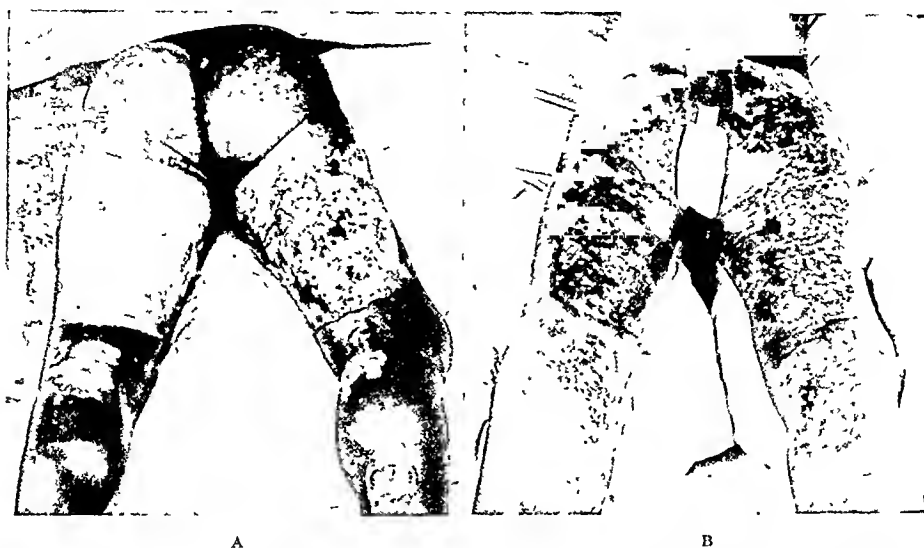


FIG. 3. Patient S. H. with nearly identical second and third degree burns of both buttocks and thighs, her left side treated with Foille, her right side with sulfadiazine. A, appearance about fifth hospital day; B, photograph one-hundred first day; Foille side healed; several unhealed patches (outlined in ink) remain on sulfadiazine side.

removed at the periodic wound toilette and there were no adhering outer dressings to take off.

TABLE X  
INCIDENCE OF STAPHYLOCOCCUS AUREUS AND  
STREPTOCOCCUS HEMOLYTICUS IN BURNS

Agent	Staphylococcus Only		Staphylococcus and Streptococcus		Streptococcus Only	
	Cases	Per Cent	Cases	Per Cent	Cases	Per Cent
Foille.....	25	44.6	30	53.6	1	1.8
Tan.....	12	48.0	13	52.0		
Sulfa.....	17	70.8	6	25.1		
C. L. O....	2	66.6	1	33.1		

*End Results.* This is difficult of evaluation and follow-up. It has been our clinical impression that deeper burns, especially those of the face, hands and flexures, heal somewhat more kindly and with less tendency to contracture when treated with Foille than with any other agent. Figures 5, 6, 7 and 8 illustrate the results

the presence or absence of contractures in the third degree burns of this series depended more upon when and how successfully the skin graft had been carried out

TABLE XI  
PAIN CONTROL

Agent	Total Cases	Control of Pain, Per Cent		
		Good	Fair	Poor
Foille.....	81	61.7	29.7	8.6
Tan.....	37	70.3	24.3	5.4
Sulfa.....	23	65.2	26.1	8.7
C. L. O.....	9	55.5	33.3	11.1

than upon the local application chosen. It is inexcusable to omit or put off skin grafting because some favorite vulnerary reputedly "stimulates healing."

#### CONCLUSIONS

It should be recalled that one purpose of this study was to find a treatment adapted to conditions far from ideal, such as prevail

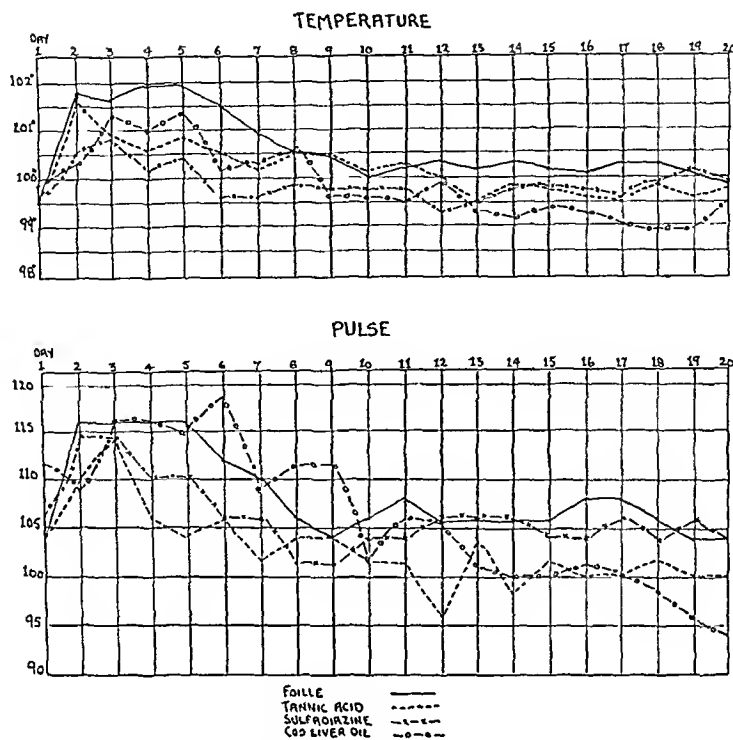


FIG. 4. The average highest daily temperature and pulse of the four therapeutic groups for the first twenty hospital days.



FIG. 5. Patient C. F. with deep second and third degree fire burns of face, hands, arms, chest and thighs treated with Foille. A, just after removal of initial Foille compression dressings, the fourteenth hospital day. Note the third degree burns of the forehead and hands. B, just before final healing; the hands have been pinch-grafted.

in understaffed charity institutions or military hospitals in war time. No mere local application is a substitute for special

I agree with Crile<sup>23</sup> that the sloughing stage of the deeper burns is one of inevitable, even if low-grade, sepsis. It presents



FIG. 6. Patient W. R. with deep tar burn of extensor aspect of left hand. The extensor tendon of middle finger was exposed and partially sloughed. Treated with Foille. A, appearance when healing was well underway, about the thirtieth day; B and C, shortly after final healing, which occurred the ninety-fifth day.

nurses, close meticulous surgical care and elaborate equipment.

The therapeutic problems presented by second and third degree burns are vastly different because of the total destruction of corium and skin-regenerating powers in the latter. Second degree lesions aseptically treated will heal kindly regardless of the

the problem of early-as-possible removal of the gray necrotic corium, of unroofing underlying pus pockets and of timely skin graft. In our experience this stage is much more simply and efficiently dealt with if there is no tough eschar in addition to the human leather or dermis to be removed. So far at least Foille has approached nearer the



FIG. 7. Patient T. H. with very deep second degree fire burns of both hands and forearms treated with Foille. A, appearance about the seventh hospital day. B, appearance shortly after final healing on the twenty-third day.

agent used. We have found nothing superior to combined tannic acid and silver nitrate for simplicity and effectiveness. The sulfadiazine eschar, though more antiseptic, requires too long to form and is definitely inferior to that of tannic acid, when the burned surface is subject to masecration, distortion or pressure.

ideal than the other agents during this phase, although we have not yet given the Lohr treatment sufficient trial. Applied alone and without other dressings, it forms a soft, protective, mildly antiseptic coating that thoroughly permeates all crevices and pockets. This aids in softening the leathery corium and is easily sponged or soaked

away at the daily toilette. No anesthetic has ever been required for the periodic débridements in Foille patients.

4. Foille is superior to the other agents as a dressing for deeper burns, in the following respects: (1) Simplicity of applica-

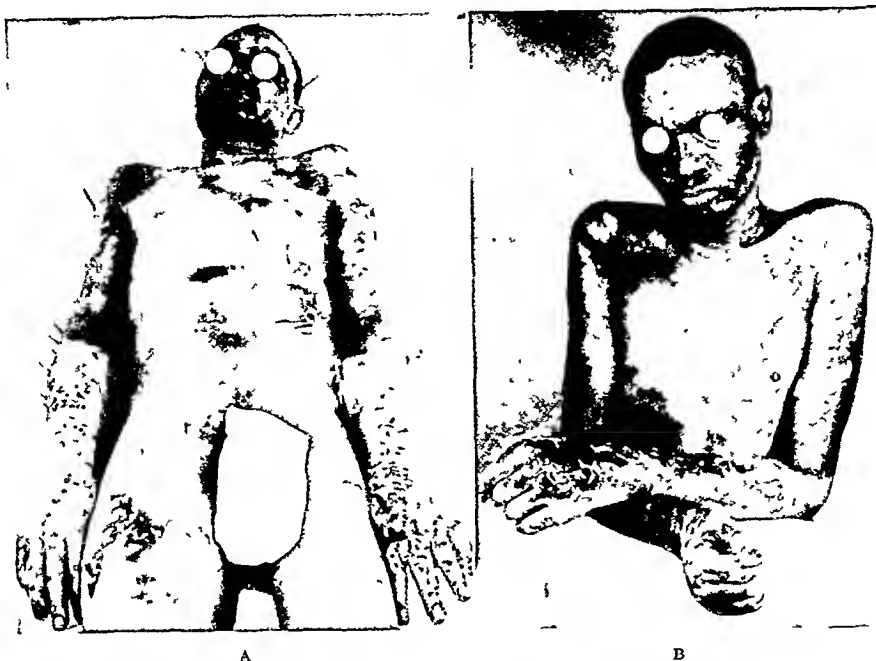


FIG 8. A, patient D. B. with deep second and third degree gasoline explosion burns of face, chest, arms and hands, just after removal of initial Foille compression dressing on fourteenth day. B, same patient just after healing on the seventy-third day. Note the newly healed "postage stamp" skin grafts on left hand and arm.

Needless to say, Foille is not beyond improvement. Promising modifications of the original régime are the initial compression type of dressing and the incorporation of 1.5 per cent sulfathiazole in place of the oxyquinoline. Whether this preparation will prove superior to a simpler sulfonamide ointment, only further investigation will show. So far it has proved a rational and valuable agent.

#### SUMMARY

1. A comparative study has been made in 199 burns of four topical applications: Foille, tannic acid, sulfadiazine and cod liver oil.

2. These agents are of about the same value in the saving of life.

3. Superficial burns, correctly treated, heal kindly whatever the local application. Here the tannic acid and silver nitrate treatment has the advantage of simplicity.

tion; (2) it significantly reduces the healing time of third degree burns; (3) it acts as a detergent for grease and oil, and (4) it forms a soft, mildly antiseptic, easily changed coating, ideally suited to infected burns, to burns of the hands, face and genitalia, and to the sloughing stage of third degree burns.

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FOR perforating wounds of the abdomen the use of cyclopropane with an intratracheal tube is indicated if a gas is used as an anesthetic agent.

# SYNDROME OF ACUTE APPENDICITIS\*

## THE FREQUENCY OF OTHER CONDITIONS RESPONSIBLE FOR SYMPTOMS

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THE syndrome ascribed to acute appendicitis is not specific for the disease, and indeed, conditions which can give rise to this symptom-complex constitute an impressive list.<sup>1</sup> Fortunately, the diagnosis can be made in the majority of cases.<sup>2</sup>

The low morbidity and mortality subsequent to the removal of the unruptured appendix is apparent in most statistics, and has properly swayed the surgeon toward early operation.<sup>3</sup> There is still, however, a tendency on the part of some practitioners to delay operation until a "definite" diagnosis can be made. Appendicitis is a protean disease with manifestations which are often baffling, and this temporization caused by uncertainty as to diagnosis on the part of the physician, and occasionally the failure of the patient to secure early consultation, often results in complications such as perforation with peritonitis or abscess, considerably augmenting mortality and morbidity figures. Recently, the use of sulfanilamide in these conditions has been of great value.

It has been shown that the risk of early operation in cases of suspected appendicitis is small. Because of this many patients are legitimately explored only to find that the syndrome suggestive of appendicitis was due to some other pathologic condition, or occasionally nothing is found grossly to account for the symptoms which presented.

One hundred cases from the Second Surgical Service of the Mount Sinai Hospital, New York City, were investigated, in which the clinical picture was so strongly suggestive of appendicitis that operation

was performed within twelve, and in most instances within six to eight hours after admission, but in which exploration failed to reveal any evidence of acute appendiceal inflammation. Cases of this type were taken consecutively as they occurred over a period of five years and nine months during which time some 1100 operations for appendicitis were performed on this surgical service. The survey was conducted in an attempt to discover from the clinical record and the operative findings the presence and frequency of pathological conditions which could be held accountable for symptoms. While these cases so selected constitute errors in diagnosis, in most instances they are not errors in judgment.

Of the one hundred cases examined, 83 per cent were less than thirty years of age, 60 per cent being under twenty. That the great majority (69 per cent) were females is to be emphasized. There was a history of previous attacks of abdominal pain in 38 per cent. On admission, sixty-five had a history of generalized or midline abdominal pain with a subsequent shift to the right lower quadrant in forty-four. Eighty-eight cases began with or subsequently developed right lower quadrant pain. Nausea occurred fifty-four times, actual vomiting, forty-nine. Rectal tenderness was elicited in sixty-five instances. Forty-three of seventy-two patients in whom a white blood count was performed showed a leucocytosis (over 10,000 per cu. mm.).

It is to be stressed that while urgent operation was considered indicated in all cases, the possibility of other conditions being present was often entertained, as the list of admission diagnoses shows. (Table 1.)

\* From the Second Surgical Service of Mount Sinai Hospital, New York City.

TABLE I

## DIAGNOSIS ON ADMISSION

Acute appendicitis.....	77 times.
Acute appendicitis (?), with simultaneous diagnoses of	
Pelvic condition (?).....	15 times.
Urinary tract disorders (?).....	2 times.
Other diagnoses (?).....	6 times.

Of sixty-four cases followed from three months to three years after operation, three patients, all of whom had shown no pathological condition at exploration, had subsequent recurrent attacks of right lower quadrant pain, two were proved to have gallstones, and one continued with clinical evidence of ileocecal tuberculosis, recognized at operation. Two patients required re-operation for acute intestinal obstruction secondary to adhesions. Follow-ups in other patients were negative.

From the clinical data and the findings at laparotomy, it was possible to establish the presence of conditions accountable for symptoms in 55 per cent of cases. (Table II.)

The pathological conditions found may be separated into three large groups: (1) cases of acute mesenteric lymphadenitis, (2) acute ovarian conditions, and (3) a miscellaneous group.

Seventeen cases of acute mesenteric adenitis were encountered. Of these, three were less than ten years of age and fourteen were between ten and twenty-two. An almost equal sex incidence was found (male nine, female eight). Six, or one-third of the patients, had had previous attacks of abdominal pain. Only four presented the classical shift of pain to the right lower quadrant. Vomiting occurred seven times, diarrhea, six. Of interest is the high incidence of rectal tenderness, occurring in thirteen of seventeen cases, being generalized in seven and right-sided in six. Eleven of seventeen cases in whom blood counts were performed showed a leucocytosis of more than 10,000.

At operation free fluid was found in the peritoneal cavity in five patients. All seventeen showed definite enlargement of the mesenteric nodes draining the ileocecal region. The appendix, although

grossly normal, was removed in every case; and while all were reported by the pathologist as showing "chronic appendicitis," the additional anatomic finding in six of these cases of lymphoid hyperplasia of the appendix, is to be noted. There were no instances of sequelae in cases followed up to three years.

TABLE II

## FIFTY-FIVE CASES WITH PATHOLOGICAL CONDITIONS ACCOUNTABLE FOR SYMPTOMS

Condition	No. of Cases	Remarks
Acute mesenteric adenitis.....	17	9 male, 8 female
Acute ovarian conditions.....	16	13 right, 3 left
Rupture of Graafian follicle without hemorrhage.....	3	
Rupture of Graafian follicle with intraperitoneal bleeding.....	6	
Ruptured corpus luteum cyst with intraperitoneal bleeding..	4	
Hemorrhage into corpus luteum cyst.....	3	
Pelvic inflammatory (tubal) disease	3	2 acute, 1 chronic
Acute right pyelonephritis.....	2	
Cholelithiasis.....	2	
Acute gastroenteritis.....	5	
Miscellaneous pathological conditions.....	10	
Acute regional ileitis.....	2	
Ileocecal tuberculosis.....	1	
Pericecal granuloma.....	1	
Acute purulent Meckel's diverticulitis.....	1	
Carcinoid of appendix with mucocele.....	1	
Infarcted appendix epiploica of cecum.....	1	
Intestinal obstruction due to adhesion with infarcted loop of small bowel.....	1	
Acute right epididymo-orchitis..	1	
Acute catarrhal jaundice..... (jaundice developed on the fourth postoperative day)	1	

Sixteen patients with acute ovarian conditions were operated urgently with symptoms suggesting acute appendicitis. In thirteen, rupture of an ovarian follicle, follicle cyst, or corpus luteum cyst had occurred, usually with bloody or clear fluid present in the peritoneal cavity at

the time of operation (twelve times). In three cases there was acute hemorrhage into a right corpus luteum cyst without rupture into the abdominal cavity.

All patients but one were unmarried. Two-thirds of the group were between eleven and twenty years, the rest being under thirty. Seven had a history of previous attacks of abdominal pain. Only two patients manifested a shift from midline or generalized pain to pain in the right lower quadrant. Two cases had a history of a reverse shift of pain, starting in the right lower quadrant and becoming generalized, said to be suggestive of ovarian conditions. Vomiting occurred in five patients. Rectal tenderness was elicited in nine. White blood counts were performed in twelve patients, and in seven, the white cells numbered more than 10,000 per cu. mm. There were no sequelae in cases followed.

With regard to the third or miscellaneous group, Table II is self-explanatory. Certain cases (e.g., perforating carcinoma of the cecum), in which the appendix is usually not removed, would escape the method of case-finding employed.

#### COMMENT AND CONCLUSIONS

1. These one hundred patients presented a symptom-complex, centering for the most part about pain and tenderness in the right lower quadrant with a variable, concomitant incidence of nausea, vomiting, fever, and leucocytosis of varying degrees. In each case urgent surgery was deemed

advisable and all were explored within twelve hours after admission to the hospital. In no case did exploration disclose acute appendiceal inflammation.

2. Clinical and pathologic evidence, sufficient to account for symptoms, was found in 55 per cent of the cases.

3. Acute mesenteric lymphadenitis, affecting male and female in comparable incidence, constituted a major portion of this group.

4. Acute pelvic conditions, for the most part ovarian, were present in another large number of cases. The preponderance of females in this series was thus partly explained.

5. The large group of miscellaneous pathological conditions needs no additional comment. The low incidence of each of these conditions makes their diagnosis difficult, and many, if recognized, would nevertheless have required operative interference.

6. In 45 per cent of cases no definite acute condition was discovered.

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# INTESTINAL ANASTOMOSIS\*

## DESCRIPTION OF A NEW TECHNIC

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WITH the discovery of the process of intestinal repair by Lembert,<sup>20</sup> and the introduction of asepsis by Lister, intestinal resection began to be accepted as a definite surgical procedure. Reports of successful resections of the colon began to appear toward the end of the nineteenth century. In 1882, Thomas Bryant<sup>3</sup> reported a successful resection of the colon. He was followed by Barton,<sup>2</sup> in 1888; Bloch,<sup>5</sup> in 1892; Paul,<sup>33</sup> in 1895, and Mikulicz,<sup>27</sup> in 1903.

Independently of each other, both Paul and Mikulicz attracted the attention of the surgical profession to the principle of exteriorization. There were slight differences in the technic of exteriorization as practiced by Mikulicz and by Paul. Paul sutured together the ascending and descending bowel loops attached to the tumor, fixed them into the incision, removed the growth and tied a glass tube into the lumen of each sectioned loop. The spur thus formed was crushed and the colostomy later closed extraperitoneally by a plastic procedure. Mikulicz followed a similar technic but did not suture together the bowel loops fixed in the abdominal incision. It is to the credit of both Mikulicz and Paul that they advocated and practiced removal of an adequate portion of the mesentery with the growth at the time of the operation. Unfortunately, sufficient importance was not immediately attached to this feature of the exteriorization principle. Mikulicz<sup>27</sup> was able to report, in 1903, on sixteen resections of the colon using the principle of exteriorization. The mortality was 12.5 per cent. In comparison, he reported on twenty-one cases of resection with primary suture performed in his clinic

with a mortality of 42.9 per cent. This mortality was the average mortality for any primary suture of the colon at that time. It is not surprising, therefore, that the principle of exteriorization was so readily acceptable. However, as resections began to be more frequently practiced by exteriorization, the average mortality was found to be much higher than that originally reported by Mikulicz; and yet, never as high as with direct anastomosis.

MORTALITIES WITH EXTERIORIZATION

	Year	Per Cent
Nordmann <sup>30</sup> .....	1926	28
Cheever <sup>6</sup> .....	1913	18
MacFee <sup>21</sup> .....	1937	28
Allen and Welch <sup>1</sup> .....	1939	21
Finsterer <sup>9</sup> .....	1939	17
Grinnel <sup>14</sup> .....	1939	27
Mayo and Simpson <sup>25</sup> .....	1939	20
Wilkie <sup>46,47</sup> .....	1939	19
Paterson and Webb <sup>32</sup> .....	1940	27
Gibbon, Jr. and Hodge <sup>13</sup> .....	1941	29
Lahey <sup>19</sup> .....	1941	13

Average mortality..... 22.9

It was soon realized that if further progress was to be made in lowering the morbidity and mortality and raising the operability, other factors would require consideration. The enormous amount of experimental and clinical data which began to accumulate indicated the necessity of distinguishing between obstruction in the upper and lower intestinal tract on the one hand, and whether or not there existed an interference with the circulation on the other. The results of bowel obstruction on the physiological economy also became

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apparent. Finally, it has become possible to formulate certain principles, the practice of which has contributed immeasurably

Vitamin deficiency is restored by the appropriate administration of the necessary vitamins. Laboratory tests can quite



FIG. 1. Basting stitch is being placed below crushing clamp holding end of resected bowel. This stitch is both hemostatic and prevents soiling.

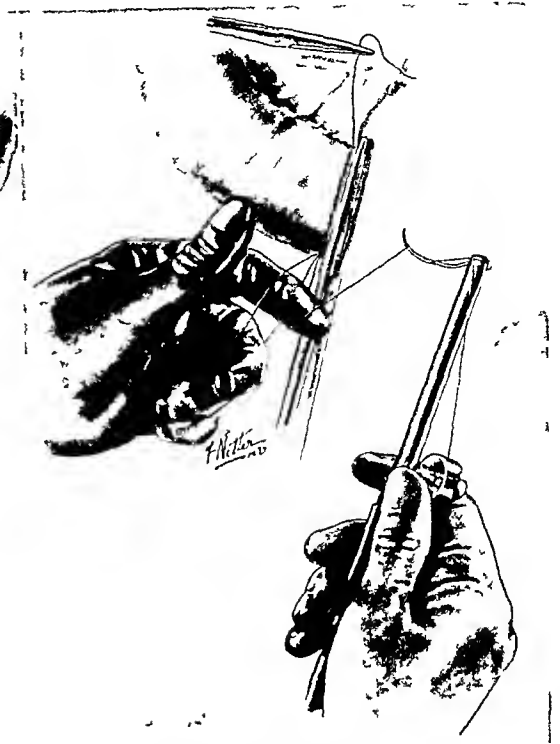


FIG. 2. The basting stitch has been completed. A half loop is in the process of formation.

toward making bowel resection a safer procedure. Briefly considered, these factors are as follows:

**Relief of Obstruction.** Whether decompression of the bowel is obtained by intubation with a duodenal tube or a Miller-Abbott technic or some form of direct bowel drainage, the same purpose will have been fulfilled. The effects resulting from a compromised circulation, and the absorption of toxic products through a weakening mucosa will cease. This is a most important preoperative measure for both large and small intestinal obstruction, provided that there has been no vascular mischief.

**Restoration of Biochemical Imbalance to a More Normal Status.** Dehydration and nutrition are readily overcome by saline and glucose infusions. Hypoproteinemia and anemia are combatted by the administration of plasma and whole blood.

accurately determine when this restoration has taken place.

**Local Cleansing of the Bowel by Lavage and the Preoperative Use of Chemotherapy.** In every resection of the colon, these preoperative measures are very important. A definite control of infection in the bowel can thus be exercised. Devine,<sup>8</sup> in his procedure of obstructive resection, has been an ardent advocate of such measures and has suggested using cod liver oil to be instilled into the defunctioned colon. The sulfa drugs have already been shown to play an important part in the preoperative phase. Garlock and Seley<sup>11</sup> were the first to report in 1939, the beneficial effect of sulfanilamide in resections of the colon, controlling *Streptococcus hemolyticus* organisms. Nine resections of the colon were reported with one death which was not due to peritonitis. Lockwood and Ravdin<sup>22</sup> reported similar

favorable experiences. Then in December, 1940, Firor,<sup>10</sup> using a new sulfa drug—sulfanilguanidine—reported his experience

intestine, because of the rich collateral circulation and generally good blood supply, both axial and lateral anastomoses can

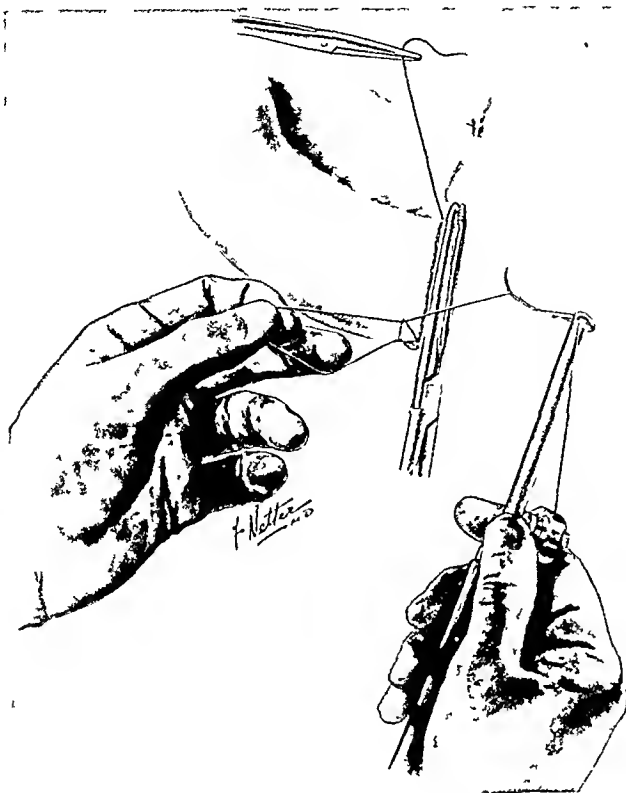


FIG. 3 Detail of half loop fixing the stitches temporarily.

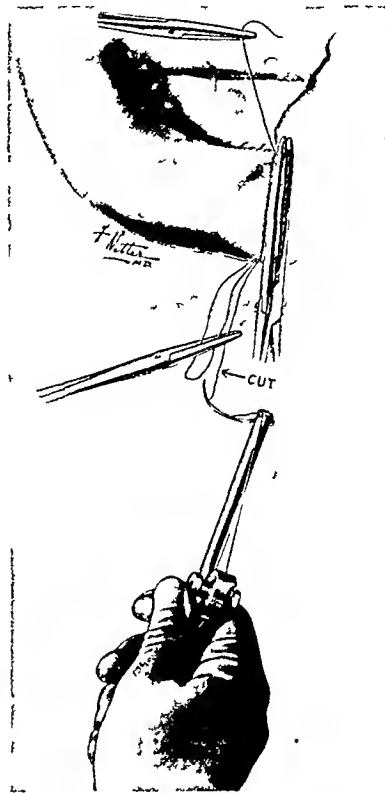


FIG. 4 The strands of the half lock stitch are held as traction sutures. The loop and single strand are so arranged that the entire basting stitch can readily be removed by pulling on the single strand alone.

in difficult resections of the colon with no fatalities and no peritonitis. In some of these cases gross soiling and contamination had occurred.

*Accuracy and Care in Operative Technic.* It is important that no resection be performed unless the bowel has been adequately mobilized. In this way, tension at the suture line will be avoided. Wilkie<sup>46</sup> even suggests dividing the longitudinal muscular bands so that the strain on the suture line will be equally distributed over its entire circumference. With the use of the closed method of anastomosis, a meticulous technic will reduce infection to a minimum. Both theoretically and practically, it is an ideal procedure for bowel resection.

In the consideration of every bowel resection there are certain intrinsic problems. Not the least of these is the local blood supply. In resections of the small

be practiced without fear of a vascular compromise, if the proper technic has been used. In the colon, however, it has been shown that the circulation is practically terminal in type, and that as the distal portions of the colon are approached, the vascularity diminishes.

Meillere,<sup>26</sup> Lockhart-Mummery,<sup>21</sup> Stewart and Rankin,<sup>43</sup> and others have pointed out the special features of the blood supply of the colon. Based on these observations, it has been suggested that in resections of the colon, the antimesenteric edge be made shorter than the mesenteric because the blood vessels run at right angles to the long axis of the bowel. The possibility of

necrosis in the suture line may thus be avoided. Infection, early and late, resulting in peritonitis, retroperitonea infection, and

ence whether a lateral, axial or terminal lateral type of anastomosis is used. Surgical experience has demonstrated that actually

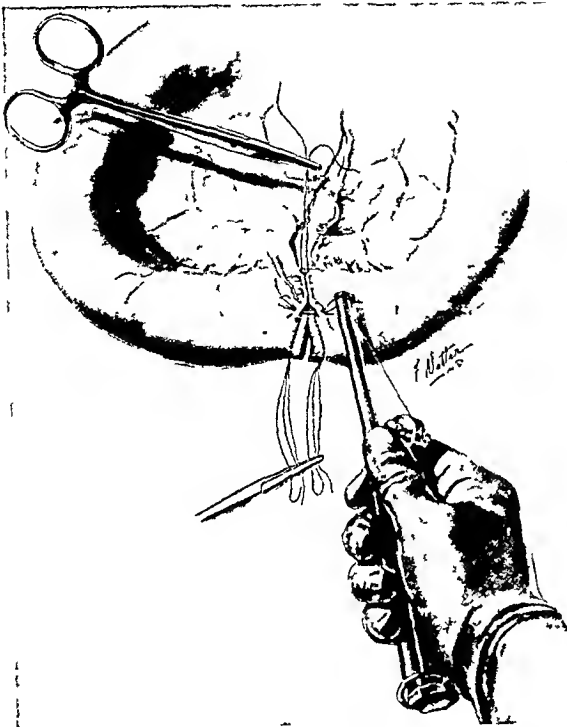


FIG. 5. The placing of horizontal mattress sutures approximates cut ends of bowels over the basting stitches on each end of bowel.

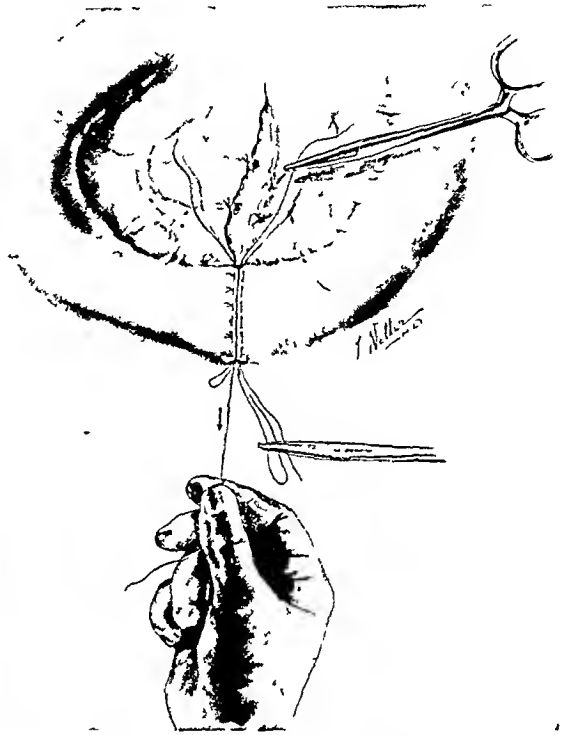


FIG. 6. The single strand is now being pulled out. Notice the corresponding loop becoming smaller. With the removal of both of these basting stitches, the temporarily closed ends of the bowel will again be open. The technic of the aseptic anastomosis has now been completed.

local abscess formation has been the greatest problem. If the circulation is adequate at the time of the operation, it may become inadequate through faulty suturing as occurs sometimes in the technic of exteriorization, or it may follow too much suturing in the performance of a direct anastomosis. Both Wilkie and Devine have advised only a single tier of stitches in direct anastomosis of the colon.

Knowing how readily anaerobic organisms thrive on devitalized tissue, there is also the possibility of a spreading gangrene from this source causing a leak in the suture line. The introduction of the newer forms of chemotherapy may overcome some of these problems. Other factors to be considered causing a leakage through the suture line are the early liquifaction of catgut and vitamin deficiency in delaying the process of repair. It makes little differ-

there is little difference in mortality between axial or lateral anastomosis. For instance, Miller,<sup>28</sup> in 1923, found a higher mortality with lateral than with end-to-end anastomosis in resections of the colon for carcinoma. Raiford,<sup>36</sup> in 1935, found that the operative mortality with lateral anastomosis was almost three times greater than with the end-to-end technic. There are, however, two serious objections to the lateral anastomosis: the one is that the blind pouches may elongate resulting in fecal stasis; and the other is that leakage may occur from the pouches themselves. On the other hand, the method interferes very little with the intrinsic blood supply of the colon and gives adequate peritoneal surfacing.

There are two basic methods of bowel resection: (1) exteriorization, and (2) direct anastomosis, open or closed. These methods have been used in resections both in the small intestine and the colon. Due to rapid dehydration and the loss of vital tissue fluids, direct anastomosis, with very few exceptions, is the method of choice for resections of the small intestine. In resection of the colon, both of the above methods are practiced.

The principle of exteriorization consists of mobilizing the bowel sufficiently to permit its safe fixation in the abdominal incision after the removal of the affected tumor. An adequate area of mesentery is resected at the same time to remove lymphatic structures when the operation is performed for malignancy. The antimesenteric edges of the two limbs are sutured together and fixed in the wound and the tumor is then removed. A variety of clamps are used to keep the stomas closed and help in their wound fixation. Rankin<sup>39</sup> has described such a device. Sometimes a small catheter is implanted into the proximal segment beneath the clamp to control distention and permit it to be left on longer. The peritoneum is carefully sutured about the limbs of the colon to effect complete closure. After twenty-four hours, the spur is crushed with an enterotome converting the double barrel into a single barrel colostomy. Sometimes this colostomy will close spontaneously, but most often a plastic closure becomes necessary later.

The principle of exteriorization has also been advocated in right colon resections to restore continuity between the ileum and the transverse colon.<sup>18</sup> This method, however, has been used mostly in resection of the sigmoid. There are surgeons who will use it in cases of dilated and distended bowel in which the possibility of postoperative infection from leakage through the suture line may occur. It has been claimed that it is the preferred procedure in elderly patients because the procedure is graded. The prolonged convalescence which in-

creases the risk of cardiovascular renal complications and which from an economic viewpoint, may be a hardship to the patient, is hardly an argument for exteriorization as a graded operation. It is interesting to note that after many years of experience with this method that its use is becoming less general. There are several reasons for this changed attitude: (1) The technical limitations prevent sufficient radical extirpation of the bowel and mesocolon for malignancy except in a limited group. (2) It is often impossible to mobilize the sigmoid sufficiently in fat and elderly patients to permit fixation of the colon in the wound.

The procedure, therefore, cannot be considered very flexible in its application. With the placement of the ends of the colon in the incision without proper mobilization, the resulting tension may cause a leakage through an unfortunately placed fixation suture, or subsequent retraction of the stomas toward the peritoneal cavity, may cause an opening in the peritoneal cavity resulting in peritonitis. Infection often occurs in the wound delaying healing. Many of these patients, after recovery, will have weak abdominal wounds which may later result in hernia formation.

Cheever,<sup>6</sup> in reporting a series of resections of the colon, states that the average hospitalization with direct anastomosis was forty days. When using the principle of exteriorization, the hospitalization period was fifty-six days. Mayo and Simpson,<sup>25</sup> in reporting their experiences, state that for resection and primary anastomosis, the period of hospitalization was twenty days as compared to fifty-nine days with exteriorization. It is also interesting to note in Cheever's report that 50 per cent of the patients treated by direct anastomosis were healed on discharge and 27 per cent had a fecal fistula. With the exteriorization technic, only 30.7 per cent were healed on discharge and 53.8 per cent had a fecal fistula. Rankin,<sup>37</sup> in 1930, in reviewing a large series of cases using the exterioriza-

tion principle, reported a recurrence in the wound of 12 per cent. This is another serious disadvantage of the operation.

The principle of exteriorization is surgically sound. Its usefulness will be determined by its own special limitations. Because of the objections cited above and the advances made in our being able to recognize and combat the serious changes resulting from intestinal obstruction, attention has again been drawn to the method of direct anastomosis. Based upon our newer knowledge of physiology and biochemical imbalance, it has been possible to prepare patients adequately pre-operatively so as to permit a primary resection and direct anastomosis.

DIRECT ANASTOMOSIS—OPEN METHOD		
	Year	Per Cent
MacFee <sup>24</sup>	1937	18 8
Gibbon, Jr. and Hodge <sup>13</sup>	1941	38
Allen and Welch <sup>1</sup>	1939	23
Stone and McLanahan <sup>44</sup>	1939	26
Mayo and Simpson <sup>25</sup>	1939	11
Cheever <sup>6</sup>	1913	15 3
Average mortality		22

ASEPTIC ANASTOMOSIS		
	Year	Per Cent
MacFee	1937	16
Wilkie <sup>46</sup>	1934	12
Allen and Welch	1939	11
Stone and McLanahan	1939	11
Gibbon, Jr. and Hodge	1941	13
Gibbon <sup>12</sup>	1932	20
Schoemaker <sup>41</sup>	1921	8
Average mortality . . . .		13

It will be noted from studying the table that the mortality using this principle is about the same as the mortality with the Mikulicz procedure without the many disadvantages of the latter. One must bear in mind that a primary resection and direct anastomosis presupposes today a careful preoperative preparation as outlined above.

There is still considerable prejudice toward the use of direct anastomosis as a routine procedure, particularly with resections of the left colon. The principle has been criticized because of the possibility of introducing infection during performance of the procedure. Furthermore, there was the possibility of delayed leakage through the suture line because of a compromised circulation. These criticisms are particularly leveled at axial anastomoses. Furthermore, it has been feared that an axial anastomosis will not function properly. Joll<sup>15</sup> states that in over 200 cases, he has not had a single failure of a properly functioning axial anastomosis. The objection that with an open anastomosis there is little control over the possibility of infection is a valid one and has been so recognized. Over 200 methods of anastomoses have been described in the literature, truly an indication of what this problem holds for the surgeon in his efforts to control infection. According to Gibbon, Jr. and Hodge,<sup>13</sup> since 1908, forty-six of the 200 methods are of the so called "aseptic type." The term "aseptic anastomosis" is inaccurate. Many of these methods so described in reality consist rather of procedures to control the possibility of infection at operation and reduce it to a minimum. Very few can be strictly classified as aseptic. The term "closed anastomosis" would be more correct. Even though some contamination may occur during the performance of such a procedure, it never becomes the same problem as when suturing is performed through the exposed lumen of the bowel. It must now become evident that the closed method must be given the attention which it heretofore has been denied. The method about to be described is both simple and practical.

TECHNIC

This closed method of anastomosis is based upon three principles: (1) The placement of a certain type of lateral locked stitch which effectively controls bleeding and leakage, whether from the resected

colon or small intestine below the clamps holding the resected ends of the bowel; (2) hardly any devitalized tissue need be included in the anastomosis; (3) the size of the diaphragm is extremely small, because the approximation is made over a suture and not over clamps. This technic of anastomosis has been found applicable for axial, lateral and terminal lateral anastomoses, not alone of the bowel proper but in subtotal gastrectomy in place of the dePetz clamp.

In this technic, a lateral locked stitch is placed with the Singer Surgical Stitching Instrument a few millimeters below the clamp holding the resected bowel. The beginning of this stitch is not tied, but is held in a fixed position by means of a small anchoring hemostat. When this stitch has traversed the full width of the bowel, it is temporarily fixed by an incompleting half lock stitch as shown in the illustrations. From experience gained with the use of this method, the crushed portion of the bowel held in the clamps, was removed before beginning the anastomosis. The illustrations show the original technic in which this crushed tissue was not removed. By removing this devitalized tissue, it is believed that the possibility of infection in the suture line can be reduced still more. In using this particular type of retaining stitch, it has been found that after the anastomosis has been completed, the size of the resulting diaphragm is very small. After the mattress sutures have been placed as shown in the illustrations, the clamp is released from the incompleting half locked stitch. By pulling on the retention stitch in the same direction in which it was placed, it will be found that it can be pulled out with the greatest of ease. Finger manipulation to make certain of the patency of the anastomosis completes the operation. The amount of contamination which has resulted in suturing through the entire bowel thickness apparently has not made the least material difference as far as infection is concerned. There is no important difference when using this technic for colon

resections. The appendices epiploica may offer some problem here, but by carefully dissecting them back and not too deeply so as not to injure the underlying terminal artery, the surgeon can easily dispose of this problem. This technic can be used equally well with silk, cotton, nylon or fine chromicized catgut.

The rôle of the Miller-Abbott tube for relieving distention in the small intestine proximal to the suture anastomosis has been found to be extremely helpful in promoting a smooth postoperative course. When direct anastomosis was practiced on the colon, a cecostomy was found to be less efficient and dependable in accomplishing a thorough cleansing of the bowel and in controlling distention above the suture line. The obstructive colostomy as advocated by Devine, has been found to be the method of choice for effectively decompressing and cleansing the colon. Furthermore, the suture line was protected by the obstructive colostomy against exposure to all infectious matter until it had been demonstrated that adequate healing was present.

*Advantages.* The advantages claimed for this technic of closed anastomosis are the following: (1) This lateral lock stitch is readily placed with the Singer Surgical Stitching Instrument. (2) This retention stitch effectively controls leakage and hemorrhage from the resected ends of the bowel. (3) In certain situations in which accessibility is limited and crushing clamps are placed with difficulty, a double row of retention stitches may be placed and the bowel transected between them, very much in the manner after the placement of the staples by the dePetz instrument. (4) Hardly any crushed tissue need be turned in when making the anastomosis. Thus infection in the suture line can be minimized because no devitalized tissue will exist to encourage bacterial growth. (5) Because of the characteristics of this stitch in being sparing with the amount of tissue it requires for its placement, only a very small diaphragm is formed at the site of

anastomosis. (6) This technic is applicable to various sized structures. (7) The retention stitch is readily removed without incurring tissue trauma. (8) The same instrument, by changing the needle, may be used for making the anastomosis and closing the incision. No other special instruments are required.

#### SUMMARY

A comparison is made between the principles of exteriorization and direct anastomosis. The respective advantages and disadvantages of the Mikulicz-Paul procedure are given. The importance of preoperative preparation which forms the basis of modern colon surgery are briefly reviewed. Continued clinical experience is beginning to favor direct anastomosis; particularly, as we have begun to understand better the problems of intestinal obstruction and how to combat them effectively. It is suggested that the term "closed anastomosis" be substituted for "aseptic anastomosis." A new technic of closed anastomosis is presented and its advantages outlined.

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THE anesthetist should try to overcome the tendency to make multiple thrusts with the needle while injecting but little solution (10 cc.). Less trauma results if the needle is introduced slowly and the solution is injected rapidly.

# THE USE OF SULFAGUANIDINE AS AN INTESTINAL ANTISEPTIC\*

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FROM the studies of Marshall and his co-workers<sup>11</sup> on the experimental and clinical use of sulfaguanidine these facts have been ascertained: (1) Although the solubility of the drug in water is greater than that of other sulfonamide compounds, the drug is absorbed less completely from the gastrointestinal tract. (2) The oral administration of the compound reduces the coliform bacteria count in the feces of human subjects. (3) The action of sulfaguanidine is more specific for coliform organisms within the gastrointestinal tract than is that of other sulfonamide drugs. Thus, with regard to specificity and low absorbability, sulfaguanidine would appear to be a desirable therapeutic agent against the most common bacteria of the large bowel, the coliform organisms. This opinion has been borne out by Firor,<sup>3</sup> Marshall<sup>10</sup> and Lyon.<sup>9</sup>

indicate that sulfaguanidine is a useful therapeutic agent, a more extensive experimental and clinical evaluation of the compound is necessary. This communication presents the experience obtained at the Memorial Hospital in the clinical use of sulfaguanidine.

## CLINICAL MATERIAL

For this investigation twenty female\* and seven male† hospitalized patients were studied. The average age of the entire group was forty-nine years and ranged from thirty-one to seventy-two. All the female patients except one had recently undergone radical mastectomy for carcinoma of the breast, and she had a chronic radiation ulcer of the chest wall. All males had diseases of the rectum or sigmoid colon. In each of the male patients some type of surgery on the colon was done. Six had carcinoma of the colon or rectum and one had chronic diverticulitis. The patient with chronic diverticulitis and two others of the male group had colostomies as a result of previous surgery. The remaining four patients had carcinoma of the colon. They had not undergone any surgical procedure previous to this study.

TABLE I

	Gm. of Compound Added to Feces	Gm. Recovered	Per Cent Recovered
Sulfaguanidine.....	3	2.91	97.0
Sulfathiazole.....	3	2.83	94.3
Sulfapyridine.....	3	2.81	93.3

Firor has obtained satisfactory results when the drug was administered therapeutically in the preparation and post-operative care of patients submitted to surgery of the colon. Marshall and Lyon<sup>9,10</sup> likewise reported good results in the treatment of acute bacillary dysentery when the drug was administered early in the course of the disease. Although such reports

## METHODS

*I. Dosage.* In order to evaluate the effect of sulfaguanidine 4 Gm. of the compound were administered orally every eight hours to each patient. This dosage is comparable to that used by Firor<sup>3</sup>—50 mg. per kilogram of body weight.

\* From the Breast Service of Dr. Frank E. Adair.

† From the Mixed Tumor Service of Dr. George T. Pack.

\* From the Memorial Hospital, New York City.

*II. Laboratory Studies. a. Sulfaguanidine levels in blood and urine* were determined by the method of Bratton and Marshall.<sup>1</sup>

The concentration of the free compound in the blood of each patient was determined at least three times weekly. The amount of the acetylated sulfaguanidine in the blood was not measured.

Both acetylated and free forms of the compound were determined in twenty-four-hour collections of urine at least four times weekly in each individual. In addition to the quantitative determination of sulfaguanidine in urine, the urinary sediment was examined microscopically for crystals of the compound.

*b. Sulfaguanidine Excretion in Stools.* In order to determine the amount of the compound in the feces it was necessary to modify the method of Bratton and Marshall for the determination of sulfaguanidine in urine. This was done in the following manner:

The specimen, collected in a large covered pail, was transferred to a wide-mouthed jar with approximately 1,500 cc. of hot water. Rotary mixing by means of an electric stirrer was carried out for fifteen to thirty minutes until a suspension of uniform consistency was obtained. At the end of this period, the total volume of the fecal suspension was taken and two aliquots of 10 cc. each were measured immediately into graduates for duplicate determinations. Each aliquot was extracted with at least four 50 cc. portions of boiling acetone. The combined acetone extracts were filtered and made to a volume of 250 cc. A 1 cc. aliquot of the yellow filtrate was measured into a test tube containing 0.5 cc. of 8 per cent hydrochloric acid and 8.5 cc. of distilled water. The color was developed as described by Bratton and Marshall.

The following precautions are necessary in order to insure a proper determination: (1) The volume and the aliquots of the fecal suspension must be taken immediately on cessation of stirring; otherwise the suspension will not be uniform. (2) The

volume of the fecal suspension must be greater than 1,500 cc. in order that turbidity of the final solution may be avoided.

*Calculation:*

$$\text{Total Gm. in specimen} = \frac{(s)(cs)}{(u)} \times 0.025 \times \text{volume of fecal suspension.}$$

s represents the reading of the sulfaguanidine standard, u the reading of the unknown, and cs is the concentration of the standard.

*c. Hematology.* On alternate days determinations of hemoglobin and counts of the erythrocytes, leukocytes and platelets were made.

*d. Blood Chemistry.* The levels of serum proteins,<sup>22</sup> plasma prothrombin,<sup>23</sup> cholesterol and cholesterol esters,<sup>15</sup> bilirubin and blood urea were determined before, during and after therapy.

*e. Bacteriology.* A minimum of three stool cultures and colony counts of the coliform bacteria were made of the feces of each patient. These cultures were grown on desoxycholate media. In most patients daily bacteriological studies were made unless for some reason a specimen of feces could not be obtained. An attempt was made in all instances to secure a culture and colony count of coliform organisms in the stool specimen before the drug therapy was started. After administration of the sulfaguanidine was begun no cathartics were given except to those patients who were prepared for surgery of the colon.

A  $\frac{1}{10}$  Gm. portion of stool was employed. A  $\frac{1}{100}$  dilution of stool previously homogenized with sterile physiological saline was made. Of this dilution 0.1 and 1.0 ml. samples were added to 20 ml. of desoxycholate media and the whole poured into sterile Petri dishes. After forty-eight, seventy-two and ninety-six hours of incubation at 35°C., colony counts on each culture were made.

p-Aminobenzoic acid in concentrations of from 1 to 5 mg. per 100 ml. has been shown to be effective against the bacteriostatic action of sulfapyridine, sulfathiazole

and sulfanilamide.<sup>2,5,8,13,16,19,23</sup> Therefore, 5 mg. of p-aminobenzoic acid were added to 100 ml. of desoxycholate media in order to ascertain whether sulfaguanidine was bacteriocidal or was bacteriostatic for the coliform organisms. Duplicate colony counts were made on the stools using the media containing p-aminobenzoic acid.

RESULTS

The results of this investigation are grouped under the following headings: (1) Studies of the absorption and excretion of the drug; (2) the effect of sulfaguanidine on the coliform bacteria of the bowel; (3) the effect of the compound on the patient; and (4) the use of sulfaguanidine in surgical patients.

TABLE II

Amount of Drug Given	Recovered in Feces		Recovered in Urine	Total Recovery of Dose Given
	First 3 Days	Second 3 Days		
6 Gm.....	2.50 Gm.	0.91 Gm.	0.76 Gm. 0.67 0.30 0.017	85.7%
	3.41 Gm. (56.6%)		1.747 Gm. (29.1%)	
6 Gm.....	3.38 Gm.	0.54 Gm.	0.5 Gm. 0.4	80.3%
	3.92 Gm. (65.3%)		0.9 Gm. (15%)	

I. Absorption and Excretion: a. Recovery of Sulfaguanidine from the Excreta. In order to demonstrate that sulfaguanidine could be determined satisfactorily, two types of recovery experiments were carried out. First, known amounts of sulfanilamide, sulfathiazole or sulfaguanidine were added to feces from normal individuals. Table 1 demonstrates that recoveries from 93 to 97 per cent were obtained. Secondly, one dose of 6 Gm. of sulfaguanidine was administered to each of two patients. The

urine and feces of each patient were collected and analyzed for the drug over a period of six days. Table II presents the results of the excretion of sulfaguanidine in two patients yielding total recoveries of 80 to 85 per cent.

Had the collection of the excreta been carried out for a longer period, it is believed that a somewhat higher quantitative yield might have been obtained. The somewhat lower recovery of sulfaguanidine after the ingestion of the compound is not due to the presence of the acetylated derivative of the drug, since hydrolysis of several extracts of fecal material from different patients gave no increased color reaction. These results indicate that the method employed is satisfactory for clinical studies.

b. Excretion of Sulfaguanidine in Feces. From Table II it is evident that the amount of sulfaguanidine recovered from the stools varies in each patient. This variation appears to be governed, most likely, by the amount of the compound absorbed from the gastrointestinal tract.

Hubbard et al.<sup>7</sup> have studied two patients with biliary fistula to whom sulfaguanidine was administered. In neither patient was there any evidence to show that appreciable concentrations of free sulfaguanidine occurred in bile. No test for the presence of acetyl sulfaguanidine was carried out.\* In order to account for the absence of the acetylated derivative in the feces of these patients two possibilities exist: first, that no appreciable quantity of the acetylated derivative of sulfaguanidine is excreted into the gastrointestinal tract through the bile; secondly, that whatever acetylated sulfaguanidine is excreted with the bile is either hydrolyzed by bacterial action or is preferentially absorbed through the walls of the gastrointestinal tract and excreted in the urine.

c. Excretion of Sulfaguanidine in Urine. The free and acetylated sulfaguanidine excreted by each patient in twenty-four-hour periods was determined by the

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method of Bratton and Marshall. In 166 determinations the average total sulfaguanidine excretion in the urine was 1.71

patients were any signs of toxicity noted. The sulfaguanidine concentration in the blood remained low, probably because that

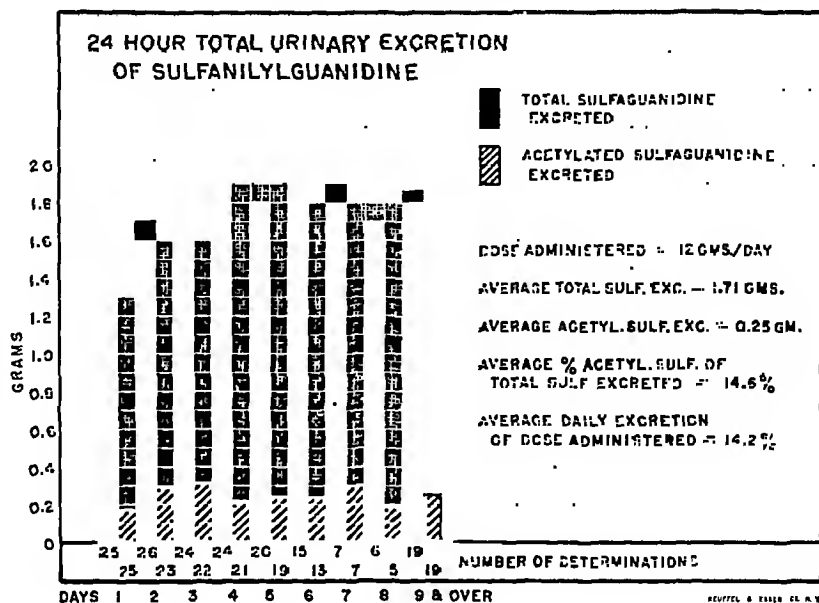


FIG. 1.

Gm. per day. (Fig. 1.) The average daily urinary excretion of acetylated derivative was 0.25 Gm., or 14.6 per cent of the total.

The amount of compound recovered from the twenty-four-hour urine specimens of each individual patient varied considerably. The range found for the patients studied was from 0.2 Gm. to 5.6 Gm. Of the sulfaguanidine administered the average excretion in the urine was 14.2 per cent of the total daily dose. Therefore, despite its solubility the greatest proportion of the compound remains in the bowel in a sufficiently high concentration to act as a local chemotherapeutic agent.

*d. The Concentration of Sulfaguanidine in the Blood.* The amount of absorption of the 4-Gm. doses of sulfaguanidine administered every eight hours is reflected in the blood levels obtained. The levels here reported are only those of free sulfaguanidine. The blood level concentrations ranged from 2 to 4 mg. per cent, and of ninety determinations, the average was 2.1 mg. per cent. In only two instances was a level of more than 5 mg. per cent (5.6 and 5.8 mg. per cent) found, and in neither of these

portion of the drug absorbed is excreted rapidly in the urine. Abnormal individual absorption or renal dysfunction may result in an accumulation of the compound in the blood but these variables were not observed in any patients of this series.

*II. The Effect of Sulfaguanidine upon the Coliform Organisms.* A wide variation in the number of coliform organisms on the culture plates is found normally. In the feces of patients used as controls the coliform organisms ranged from tens of thousands to billions of colonies per ml. of wet sediment of stool. This wide variation was noted also in the control coliform colony count from feces of the patients who subsequently received sulfaguanidine. (Fig. 2.)

The addition of p-aminobenzoic acid to the desoxycholate media did not alter the coliform bacteria counts in 99 per cent of all stool cultures made. When no growth of coliform organisms was found on either type of media, incubation was continued for another four days. After this continued period of incubation further growth appeared on the p-aminobenzoic acid media in only two of 168 cultures. It would ap-

pear, therefore, that when the coliform organisms have not grown upon either type of media after four days' incubation under

patients and not in others. The possible explanations are (1) existence of ulcerative lesions within the bowel, (2) the infre-

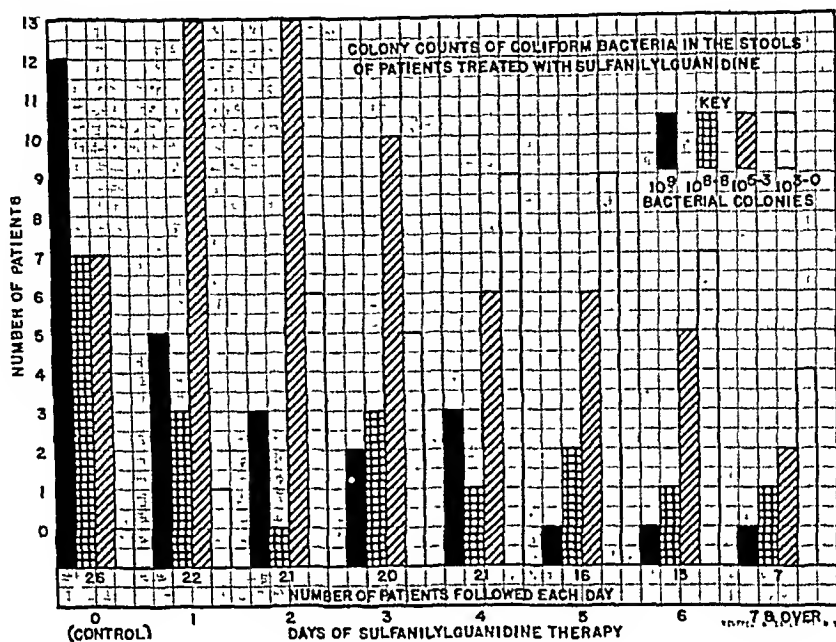


FIG. 2.

optimum conditions, no further growth can be expected.

When a known sulfonamide inhibitor, p-aminobenzoic acid in concentrations of 1 to 5 mg. per 100 ml., is added to culture media, Janeway<sup>8</sup> has shown that bacteria which are inhibited by the bacteriostatic action of any sulfonamide will grow if any viable organisms are present. From the evidence previously presented, it appears that in those individuals in whom the administration of sulfaguanidine reduced the coliform flora, the action of the compound was bactericidal and not bacteriostatic.

On the whole sulfaguanidine was effective in reducing the number of coliform organisms in the stools. (Fig. 2.) Of twenty-seven patients, eighteen showed a reduction from  $10^9$ -8 (billions or hundreds of millions) to  $10^3$ -0 (thousands or no growth) colonies per ml. in the coliform organisms grown from their stools. In the other nine no significant therapeutic effects were obtained.

There was no immediately apparent explanation for the reduction in coliform organisms which was effected in some

quency of administration of sulfaguanidine, and (3) the presence of drug-resistant coliform bacteria in the intestinal flora.

Of the nine patients whose intestinal bacterial flora apparently were unaffected by the administration of sulfaguanidine, four had ulcerative lesions of the sigmoid colon or rectum. The presence of a sulfonamide inhibitor in pus and in other autolysed tissues has been demonstrated.<sup>12</sup> The exudate from an ulcerated bowel lesion may be of such quality, or exist in such quantity, that it will neutralize the bacteriostatic or bactericidal action of sulfaguanidine. It has been shown also that the clinical course of patients with chronic ulcerative colitis is not affected by sulfaguanidine.

After the administration of sulfaguanidine to three patients who had colostomies with intact mucosa above the stoma, satisfactory reduction in coliform bacteria was noted. This result indicates that when the mucosa is intact good therapeutic responses are obtained. Therefore, a marked reduction in coliform organisms can be obtained in the segments of colon above the sigmoid and rectum. This fact may be

important from a prophylactic standpoint. If an ulcerative lesion in the sigmoid is removed surgically, the line of anastomosis thus will not be bathed with intestinal contents which contain excess coliform organisms. Such organisms are inhibited likewise in the postoperative period when sulfaguanidine is administered.

No explanation is at hand for the failure of sulfaguanidine to reduce the coliform bacteria count in the stools in the remaining five of nine patients. It was not determined whether or not the intestinal bacteria of those five were abnormally resistant to the drug.

From the accumulated data\* it is evident that no constant reduction in the total number of coliform organisms were obtained. Neither was there any uniformity in the rate of reduction of the bacteria. In several patients it was found that after therapy had been administered for several days the number of coliform organisms was decreasing rapidly. Then, for some unknown reason, the colony count would increase temporarily to about pre-therapy levels, but eventually would decrease again and remain at low levels. In some instances no coliform organisms could be cultured from the last stool specimen examined.

In summary, a noticeable effect of sulfaguanidine upon the coliform organisms usually was apparent from three to four days after therapy was instituted. The colony counts remained low after that time except for the occasional culture in which there appears to be an "escape" from the bactericidal action of the drug. The maximum effect of continued sulfaguanidine therapy is obtained within five to six days. When therapy was discontinued a steady rise in the coliform bacteria count began and reached pre-therapy numbers in two to three days.

It would appear, therefore, that the optimal time for surgery of the colon in patients who receive sulfaguanidine as a

prophylactic agent would be from five to seven days after the use of the compound was started. Theoretically, the postoperative sulfaguanidine therapy should be started from twelve to twenty-four hours after surgery.

*III. The Effect of Sulfaguanidine on the Patient. a. Effect on the Blood.* Complete blood and platelet counts were done on alternate days in the patients studied. Neutropenia, agranulocytosis or hemolysis never were noted. In only one patient was a significant change found in the hemogram after the administration of sulfaguanidine.

In that one patient a reduction of the hemoglobin from 65 to 49 per cent (normal 13.8 G) was associated with a fall in the erythrocytes from 3.5 to 2.9 millions. There was no significant reduction in the leukocytes. This anemia developed after administration of 48 Gm. of the compound given over a period of four days. The blood level of sulfaguanidine was never above 0.5 mg. per cent and no rise in bilirubin was noted. There was no evidence of hepatic dysfunction as determined by an increased ratio of cholesterol to cholesterol esters, or by a fall in the concentrations of serum proteins or plasma prothrombin. Subsequently, a study of the bone marrow revealed it to be moderately hypoplastic. Unfortunately, a bone marrow examination had not been made before sulfaguanidine therapy.

Since the amount of the compound absorbed by this patient was only 1.7 Gm. and represented only 3.4 per cent of the total dose administered, it was probable that the patient was sensitive to the drug. The anemia persisted for four weeks despite the parenteral administration of 45 units of concentrated liver extract per week and ingestion of 45 gr. of ferrous sulfate per day.

*b. Effect on the Liver.* In order to detect the possibility of hepatic damage after use of sulfaguanidine the following studies were made:

In twenty-two of the patients serum protein values were determined both before and after sulfaguanidine therapy. Five

\* Due to lack of space a large table presenting all the data outlined in the text of this article has not been included.

patients had pre-therapy levels below the normal value of 6.5 Gm. per 100 ml. Significant decreases in the serum protein values below the initial values were not found in any patient.

In eighteen patients the ratio of free to total cholesterol in the serum was likewise determined before and after therapy. A normal ratio of from 25 to 33 per cent was noted in every patient.

In sixteen patients no retention of bilirubin was observed.

In twenty six patients the plasma prothrombin was determined. A decrease of prothrombin values of 20 per cent was considered to be significant. Five of the twenty-six patients developed significantly low levels during the course of sulfaguanidine therapy.

It was important, therefore, to determine whether the development of hypoprothrombinemia was due to hepatic damage<sup>17,18,21</sup> or to some other cause. It has been accepted that vitamin K is synthesized from dietary factors by the activity of bacteria in the intestine,<sup>4,14</sup> and it was possible that the administration of sulfaguanidine destroyed those organisms in the intestine which are responsible for the synthesis of vitamin K. To ascertain the facts concerning this question two of the five patients with hypoprothrombinemia were given 2 mg. of synthetic vitamin K<sub>1</sub> (2-methyl-1, 4-naphthoquinone) parenterally. The administration of this compound was followed in both by a rapid return of the plasma prothrombin values to the pre-therapy levels. The three other patients were not given vitamin K, but when the sulfaguanidine was discontinued a rise in the plasma prothrombin levels followed within four days. This experiment would indicate that the hypoprothrombinemia which followed sulfaguanidine administration was not due to a deranged fabrication of prothrombin by the liver, but to a decreased synthesis of the vitamin K by the intestinal flora. This conclusion is supported by the finding that in every patient who showed a decrease in plasma prothrombin a significant reduction

in the coliform bacteria count of the stools was found.

The values of serum proteins, the ratio of free to total cholesterol, and the values of bilirubin and plasma prothrombin, determined in a significant number of patients, indicated that no significant alterations in liver physiology could be attributed to the use of sulfaguanidine.

*c. Renal Function.* Despite the fact that a relatively small percentage (14.2 per cent) of the total amount of sulfaguanidine administered was excreted in the urine, signs of renal irritation were encountered in three patients. Each of these three showed microscopic hematuria which disappeared in three days after the fluid intake was increased. In the urine of one patient casts of sulfaguanidine crystals were found, and this cylindruria was associated with tenderness over the left kidney.

At some time during therapy every patient had sulfaguanidine crystals in the urine, but the number of crystals present varied considerably.

The blood urea concentration was determined in twenty of the twenty-seven patients. No patient developed concentrations of blood urea above those initially found.

*d Other Toxic Manifestations.* Of the other signs or symptoms which might be attributed to the use of sulfaguanidine, only nausea, vomiting and vertigo were encountered. Nausea and vomiting were observed in two patients, but were not severe enough to make it necessary to discontinue therapy. Two patients complained of vertigo, but no other findings were present to suggest irritation of the central or peripheral nervous systems. Cyanosis, skin eruptions, or the development of fever or jaundice never were seen.

*IV. Use of Sulfaguanidine in Surgical Patients.* In seven patients surgery of the colon was done. Briefly, the case histories of these patients are as follows:

CASE 1. This patient had a large ulcerated carcinoma of the rectum. After six days of sulfaguanidine therapy the effect upon the

coliform organisms was equivocal. There was evidence of renal irritation. Many red blood cells were found in the urine together with a large number of crystals of sulfaguanidine. The tumor was inoperable. A colostomy was made. The patient made an uneventful convalescence.

CASE II. This patient had an extensive ulcerated carcinoma of the rectum. With three days of therapy no effect on the coliform organisms was noted. The tumor could not be resected. A colostomy was made. There were no postoperative complications.

CASE III. This patient had a one-stage abdominoperineal resection for a large ulcerated carcinoma of the rectum. No effect on the coliform organisms was noted after four days of sulfaguanidine therapy. Renal irritation was indicated by the presence of many red blood cells and crystals of sulfaguanidine in the urine. The contents of the resected loop of bowel was cultured and a colony count for coliform organisms showed 100,000 colonies. The convalescence was uneventful.

CASE IV. This patient had a resection of the sigmoid for carcinoma with establishment of bowel continuity by a primary aseptic type of anastomosis. After three days of preoperative sulfaguanidine therapy there followed a reduction of the bacterial content of the stool from a count of billions to one where no coliform organisms were found by culture in the stool specimen taken just previous to surgery. Sulfaguanidine was not administered postoperatively. The patient had an uneventful convalescence and was discharged on the sixteenth postoperative day. The bowel content of the resected loop was cultured and contained four million colonies of coliform bacteria per ml. of wet sediment. This patient illustrates the difficulty which is encountered in the evaluation of the effect of sulfaguanidine. It is quite possible that this patient would have done well without sulfaguanidine therapy.

CASE V. This was a seventy-two-year-old male who had two previously unsuccessful attempts at closure of a colostomy which followed a Mikulicz type of resection for carcinoma of the transverse colon. A large ventral hernia with a marked protrusion of the bowel had developed around the midline colostomy.

After six days of sulfaguanidine therapy the stool culture contained only 1,000 colonies of coliform organisms. The peritoneal cavity was opened. A side-to-side *open* anastomosis of the loops of colon leading to the colostomy was

made, and the large colostomy stoma was closed. The entire colon was replaced in the peritoneal cavity. Seven Gm. of sulfanilamide were placed along the lines of anastomosis. Sulfaguanidine was started twenty-eight hours postoperatively. The postoperative temperature was 101°C. on the first postoperative day, and thereafter never over 100°C. No signs of peritoneal irritation developed and the wound healed per primam. In this instance the drug probably did contribute to the smooth convalescence.

CASE VI. This patient was given sulfaguanidine for sixteen days before closure of a colostomy. This colostomy had been constructed as a result of a Mikulicz resection of the sigmoid for chronic diverticulitis and bowel obstruction. A marked reduction in coliform bacteria had been effected by sulfaguanidine therapy. The operative wound healed per primam without any signs of inflammatory reaction about the wound. On the eleventh postoperative day a small fistula developed but readily closed without further operative interference. This patient had not received the drug during the postoperative period.

CASE VII. After seven days of drug therapy the stool count for this patient was reduced from millions of colonies to 3,000 colonies on the day preceding surgery. The colostomy was closed and sulfaguanidine was continued postoperatively. The first stool specimen, passed five days after surgery, showed the absence of coliform organisms. The prothrombin value decreased to 50 per cent. Two mg. of 2-methyl-1,4-naphthoquinone were given parenterally and the prothrombin increased to 81 per cent.\* The wound healed per primam without any trace of inflammatory reaction. The temperature was never over 100°C. at any time during convalescence.

The effect sulfaguanidine had upon the clinical course of these patients is difficult to evaluate. Any or all of the patients may have done well regardless of the prophylactic use of the drug.

#### DISCUSSION

The problem of the adoption or rejection of a new member of the sulfonamide

\*This patient is not considered in the group of patients discussed previously, as surgery may have been a contributing factor in lowering the prothrombin value.

group must be approached by determining whether or not the compound really is useful therapeutically in a group of conditions for which it was proposed. It is also necessary to discover the fate of the compound, its actual mode of action, and whether or not its therapeutic administration is attended by the production of any toxic effects on the patient.

From the studies presented of absorption and excretion of the compound, it is evident that there is a marked variation in the amount of compound absorbed in each individual patient. However, unlike other sulfonamide compounds in general use, sulfaguanidine is relatively poorly absorbed from the gastrointestinal tract. Thus it remains in the bowel in a sufficiently high concentration to act as a local chemotherapeutic agent. That portion of the compound absorbed is rapidly eliminated in the urine and high blood concentrations are not usually found.

Sulfaguanidine therapy did produce a marked effect upon the coliform intestinal flora in a significant number of patients. Alteration of the intestinal flora in some patients appears to retard the synthesis of vitamin K in the bowel and hypoprothrombinemia results. Reduction of coliform bacteria by sulfaguanidine in the adult results in a condition analogous to that found in hemorrhagic disease of the newborn. The prompt establishment of a bacterial flora in the newborn causes a rise in the prothrombin, probably as a result of the production of vitamin K.<sup>14</sup> Likewise the withdrawal of sulfaguanidine is followed by an increased number of coliform organisms and a rapid rise of the plasma prothrombin to normal values.

Although no patient developed a hemorrhagic crisis, a tendency to such a complication might well have been present. It is, therefore, important that the plasma prothrombin level be checked routinely before patients are subjected to bowel surgery when sulfaguanidine has been administered preoperatively.

In this study sulfaguanidine did not

cause any abnormalities in the hepatic functions measured, namely, the maintenance of a normal ratio between the free and esterified cholesterol, excretion of bilirubin, and the synthesis of serum protein and plasma prothrombin.

Sulfaguanidine may be toxic to the hematopoietic system of some patients. This finding was observed in but one instance in this study.

Although signs of renal irritation were observed in three patients, it appears fortuitous that no serious renal complications were encountered, as crystalluria was present in every patient. Oliguria, retention of nitrogenous products or signs of renal colic were never observed.

When the volume of urine excreted is low, crystalluria might present a serious hazard. The low solubility of the acetylated sulfaguanidine might lead to precipitation of crystalline deposits along the urinary tract. The maintenance of a sufficiently high fluid intake, therefore, is imperative in order to prevent massive crystalline concretions.

Other toxic manifestations in this study were relatively unimportant. The rapid elimination of the absorbed portion of the compound through the urinary tract may explain the infrequency of general toxic manifestations.

The experience obtained here of the practical application of sulfaguanidine to bowel surgery is limited. The compound appears to be of some value in selected cases. This conclusion is in agreement with the experience of Firor. Prophylactic use of sulfaguanidine thus far has its greatest merit when administered to patients who are prepared for surgery of the colon. The drug is much more effective when there are no ulcerative lesions of the bowel. Sulfaguanidine may be expected to be of use in uretero-intestinal anastomosis, closure of colostomy stomas, and in restoration of bowel continuity in the two-stage types of colonic resections when the bowel may have to be replaced in the peritoneal cavity.

In most patients a reduction in the number of coliform bacteria in the stools can be expected. In those patients whose coliform flora are not diminished markedly, the toxicity of sulfaguanidine is not sufficient to preclude its trial.

Further work on a large number of patients is needed to establish that rôle the prophylactic use of sulfaguanidine might play in the reduction of morbidity and mortality in elective surgery of the colon. The fact is to be emphasized that a rigid control study of the effect of sulfaguanidine on the bacterial flora of the bowel must be made in every instance.

#### SUMMARY AND CONCLUSIONS

1. A method for determination of sulfonamide compounds in the feces is presented. A mean average of 14.2 per cent of the total administered compound is eliminated in the urine. Usually the blood level concentrations remain low, probably because the drug is rapidly excreted in the urine.

2. The administration of sulfaguanidine markedly reduced the coliform organisms in the bowel in eighteen of twenty-seven patients.

3. When ulcerative lesions of the bowel are present, a significant reduction in the coliform organisms is not obtained. This fact would limit the beneficial results which could be expected from the use of the drug.

4. The use of sulfaguanidine resulted in an alteration of the blood picture in only one of twenty-seven patients. Nevertheless, it is advisable to check the blood counts of those who receive the compound in order to detect the occasional patient whose hematopoietic system is sensitive to sulfaguanidine.

5. The administration of this compound caused no other significant toxic reactions in twenty-six of twenty-seven patients.

6. Sulfaguanidine by its action of depressing the coliform bacteria interferes with the synthesis or absorption of vitamin K in some patients.

7. Crystalluria with subsequent formation of concretions might be considered a hazard but this complication can be overcome by giving adequate fluids.

8. Sulfaguanidine is not the ideal chemotherapeutic agent for intestinal antiseptis. A sulfonamide which can destroy all the intestinal bacteria and yet have the slow absorption and low toxicity of sulfaguanidine is to be desired.

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CERVICAL block, deep or superficial, should be completed about twenty minutes before the incision is to be made so that the nerve trunks can become sufficiently affected. Sometimes relaxation of the cervical muscles is so marked after the cervical nerves have been blocked that the patient cannot move his head without moving his shoulders.

# FIVE YEARS OF GALLBLADDER SURGERY IN A GENERAL HOSPITAL\*

## A REVIEW OF 337 CONSECUTIVE GALLBLADDER OPERATIONS

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THE 337 cases included in this review were approached with the primary purpose of studying the pathological findings as a basis for understanding the thirty-five deaths which occurred. The end results obtained in 302 patients, the "living" series, were evaluated.

Queens General Hospital is the only all-municipal hospital serving a population of about 1,300,000 in the Borough of Queens in New York City. The bed capacity is 700 and the average hospital stay is nine days. Annually, the autopsy percentage has been consistently over 58 per cent, with about 500 house autopsies being performed each year.

The types of cases studied were divided arbitrarily into those without jaundice, both chronic and acute, and patients having definite jaundice at the time of operation. The "chronic" cases had the typical history and physical findings of chronic gallbladder disease, confirmed pathologically. Classed as "acute" were cases having a typically acute clinical course with a pathological diagnosis of acute disease. Cases having the clinical features of chronic gallbladder disease with the findings of acute pathological conditions at operation were also classified as "acute." Comprising the third major group were patients in whom obstructive jaundice was present at the time of operation, with either an acute or chronic gallbladder condition being found. All cases in which carcinoma was implicated were eliminated from consideration.

### I. BASIS OF THE STUDY

The conclusions reached from this study were based on three principal sources of information: the pathological changes in the gallbladder, the causes of death, and the follow-up study.

*The pathological changes* in 306 gallbladder specimens were studied by the Department of Pathology with gross and microscopic analysis. The surgeon's description of his findings was the only report available for thirty-one cases in which neither cholecystectomy nor postmortem examination had been performed. *The causes of death* were studied at autopsy in twenty-four of the thirty-five patients who comprised the "death" series (68 per cent). Clinically, eight of the remaining eleven had "reasonably certain" factors in death, such as frank signs of spreading peritonitis or of cardiac failure. In three cases, factors in deaths were considered "probable." At a series of twelve *follow-up clinics* held specifically as a part of this study, 180 patients were interviewed and examined. Twenty-two questionnaire reports were received through the hospital's Volunteer Motor Corps which visited the homes of ninety patients who had failed to respond to repeated calls by mail. In forty-seven additional cases, notes were made available by previous clinic visits. By these methods a follow-up percentage of 75 per cent was obtained. The unreported 25 per cent, however, was proportionately distributed among the three main types of cases. Of

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the 229 "chronic" cases, 168 responded (73 per cent); of the forty-four "acute" cases, thirty-seven responded (84 per cent); and of the twenty-nine "jaundiced cases," twenty-four responded (82 per cent). Reliable comparisons of the results in each group could thus be made.

## II. THE "DEATH" SERIES

*A. Mortality Rates.* Table I, covering the mortality rates in the various groups,

TABLE I  
MORTALITY RATES

Type Case	Sex	No of Cases	Survived	Died	Mortality Rate, Per Cent	Combined M and F, Per Cent
Chronic without jaundice, 241 cases	F M	206 35	200 29	6 6	2.9 17.0	4.9
Acute without jaundice, 56 cases.	F M	39 17	31 13	8 4	20.5 23.5	21.4
Jaundiced acute and chronic, 40 cases	F M	35 5	27 2	8 3	22.8 60.0	27.5
Total		337	302	35	10.0	

indicates a low mortality rate in the largest group, chronic cholecystitis. The rate of 2.9 per cent among the females and the combined rate of 4.9 per cent compare favorably with the results obtained elsewhere. Carter et al.<sup>1</sup> reported a 3.6 per cent mortality rate for their chronic cholecystitis group. While in our series, "acute" cases had a mortality rate of 21 per cent, cases with jaundice at the time of operation proved more fatal (27 per cent). The table also shows the higher mortality rates among males. Cases in which deaths occurred were, in general, of an emergency nature. (Table II.)

*B. Factors in the Mortalities.* Study of the clinical and autopsy records showed the presence of several factors common to two or more deaths.

1. *The age and sex factors* can be considered together. (Fig. 1.) The death rate for elderly patients was higher than for

those in the younger age groups. The males were generally older than the female patients.

TABLE II  
GENERAL EMERGENCY NATURE OF THE CASES IN WHICH DEATH OCCURRED

	Death Series 35 Cases, Per Cent	Living Series 302 Cases, Per Cent
1. Cholecystograms		
a. Done.....	32	69
b. Not done....	68	31
2. Jaundice .....	31	9.6
a. With fever. ....	54	17
3. Incidence of acute pathological conditions.....	45	21
a. With perforation.....	17.1	3
4. Incidence of cardiacs .....	41	5.6
5. Incidence of patients over 50...	51	35

2. *The cardiac factor* in mortality appeared frequently. Definite heart disease was present in fifteen of thirty-five cases (41 per cent). Operation precipitated frank cardiac failure with fatal result in two patients, both apparently well compensated before operation. Especially among the cardiac patients under fifty years of age, heart failure was an important contributing factor to death. In all, nine surgical deaths could be attributed, at least in part, to the cardiac factor. In sharp contrast was the low incidence of heart disease among the patients who survived operation. Only seventeen of 302 patients (5 per cent), had a diagnosis of heart involvement made preoperatively and frank failure occurred only once.

3. *The factor of acute gallbladder disease* played a significant rôle. Acute inflammatory changes were present in sixteen cases among the deaths. Figure 2 shows its age distribution and emphasizes its more frequent occurrence among the "death" group and in the elderly male. An acute pathological condition was the main factor in death in seven of thirty-five patients. Subdiaphragmatic abscess, subhepatic ab-

scess, right lower lobe lung abscess with empyema and extensive peritonitis were some of the findings in three cases.

ease was significant mainly because it gave rise to the impaction of stones in the biliary ducts, to the fibrotic occlusion of the ducts

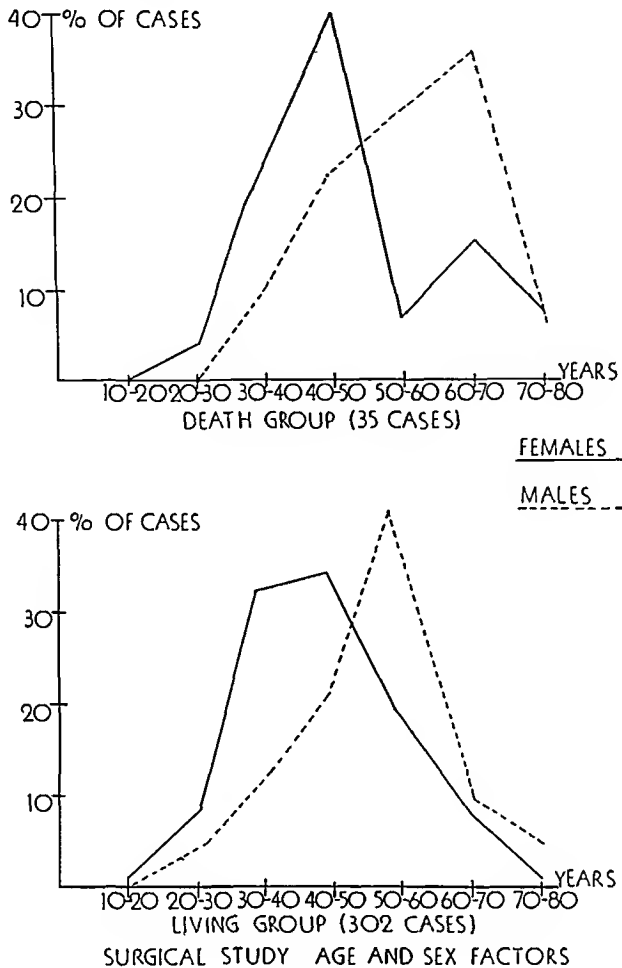


FIG. 1.

4. Closely linked to acute pathological lesions was the factor of *perforation of the gallbladder*. While this occurred relatively infrequently in the series of 337 cases (2.3 per cent) it was much more common (12 per cent) when acute cases were considered and still more frequent (27.2 per cent) when empyemas of the gallbladder alone were considered. Only two cases of perforated gallbladder were listed among the living. Thus of eight perforations, six resulted fatally (80 per cent). These findings emphasize the importance of perforation of the gallbladder as a factor in operative mortality.

5. The factor of *chronic gallbladder dis-*

and to the development of marked liver damage with biliary cirrhosis. Impacted ampullary stone was associated with two cases of fatal acute pancreatitis. Three instances of chronic pancreatitis were noted but this lesion seemed to be of little importance in the final analysis of these three deaths. Marked hepatitis was noted likewise in three cases. Obstructive jaundice resulted from fibrotic occlusion of the common duct twice and from impacted common duct stone in seven instances. No obstructing calculus could be found in two cases. The rôle jaundice played as a factor in fatality will be subjected to further analysis.

6. *The accidental factor in the mortalities* was of considerable importance. There were ten deaths that could be traced to it.

necrosis of the right hepatic lobe, occurred once, as did a duodenal tear with resulting peritonitis and a sudden death under

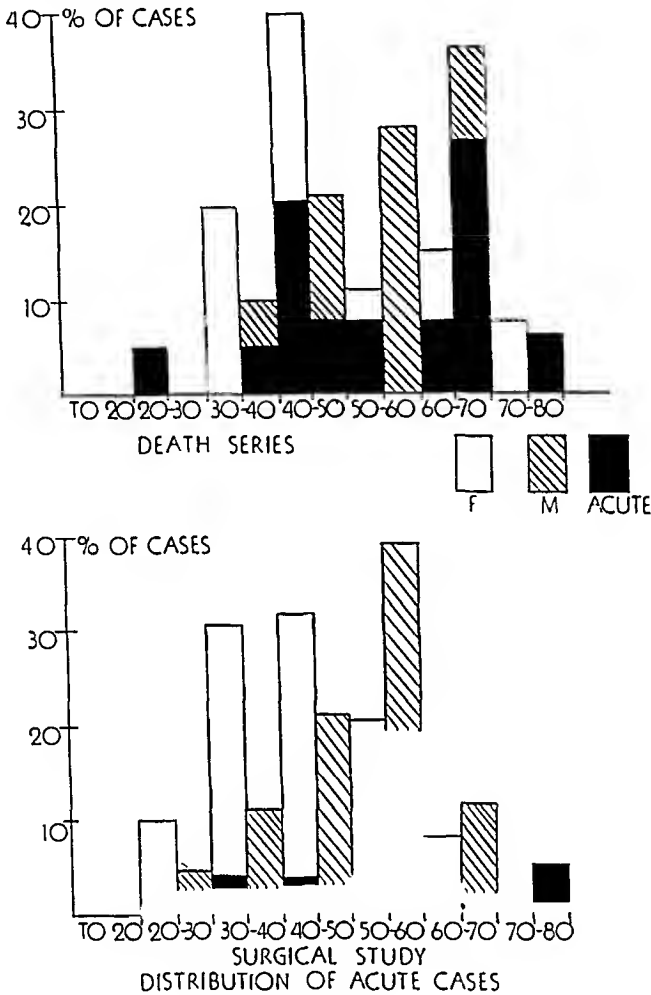


FIG. 2.

Each of these patients had postmortem examination performed. Postoperative hemorrhage caused five deaths. The site of the bleeding vessel could not be found even at autopsy in two of these. Venous varices of the common duct were identified as the source of bleeding in two others and laceration of the portal vein in the remaining one. Common duct injury was noted in two cases. One was a case of injury at a previous operation, with death resulting from a long series of complications all due to fibrotic occlusion of the duct at the site of original injury. The other was a case of accidental mass ligation of the common duct. Ligation of the right hepatic artery, with massive

spinal anesthesia before operation was begun.

7. The factor of *concomitant serious disease* was important in several deaths, though not directly related to gallbladder disease. Extensive bronchopneumonia accounted for three deaths. Each of the following was of great importance in one case: bronchogenic carcinoma with widespread metastases, concomitant ruptured appendix with generalized peritonitis, concomitant carcinoma of sigmoid colon producing intestinal obstruction, a ruptured colonic diverticulum with peritonitis and a fulminating erysipelas involving a post-operative wound.

8. *Bacteriological* reports were not available in every case. *Bacillus coli* was the most common offender in patients who died following extension of acute inflammatory processes. The occurrence of a pure culture of Friedlander's bacillus in one fatal case was considered of special interest. Other organisms encountered in this study included *Bacillus typhosus*, hemolytic streptococcus, nonhemolytic streptococcus, *Streptococcus viridans*, *Bacillus pyocyaneus*, hemolytic staphylococcus aureus, and *Bacillus alkaligenes*.

9. The *diabetic* factor in the mortalities was not apparently of great significance. Five of the thirty-five patients who died were diabetics (11 per cent), as compared to eight of 302 patients (2.6 per cent) in the living series. Scrutiny of the factors of deaths among these diabetic patients, however, disclosed that postoperative pneumonia, carcinoma of the lung, cerebral accident and concomitant ruptured appendix were the important factors in four cases. In the fifth (a patient admitted in acidosis with 4-plus glucose and 3-plus acetone) perforation of the gallbladder had occurred with an extensive contiguous pathological state. In this one case only could severe diabetes mellitus be said to have been important and, even here, the factor of acute gallbladder disease with perforation overshadowed that of diabetes itself.

10. *The factor of jaundice* as such can now be evaluated. Mortality rates were highest in those patients having jaundice at the time of operation. (Table I.) Close analysis revealed, however, that jaundice itself played little part in this series of deaths. Among the forty jaundiced patients, there were eleven deaths with post-mortem examination being performed in nine. Table III reveals that four deaths were attributable to major accidents. Two were clearly cardiac deaths. In three cases the acuteness and severity of the inflammatory process were most important. Another case was accounted for by other concomitant serious disease and, lastly, in only one case

TABLE III  
DEATH CAUSES IN THREE MAIN GROUPS  
Chronic Cases without Jaundice  
(12 Deaths in 241 Cases)

1. Acute pancreatitis.....	2
2. Accidental	
a. Duodenal tear.....	1
b. Common duct injury.....	1
c. Massive liver necrosis.....	1
d. Biliary fistula.....	1
Total.....	4
3. Cardiac.....	3
4. Concomitant pathology	
a. Erysipelas.....	1
b. Ruptured appendix.....	1
c. Bronchopneumonia.....	1
Total.....	3

Acute Cases without Jaundice (12 Deaths in 55 Cases)	
1. Acute pathology with fatal extension.....	6
2. Cardiac.....	2
3. Concomitant pathology—(Cancer of lung).....	1
4. Accidental	
a. Laceration of venous varix.....	1
b. Hemorrhage—? Source.....	1
5. Apparent cerebral accident.....	1

Jaundice Cases (11 Deaths in 40 Cases) (9 Autopsies)	
1. Accidental.....	4
2. Cardiac.....	2
3. Acute gallbladder pathology.....	3
4. Concomitant serious pathology.....	1
5. Questionable "liver" death.....	1

was the cause of death not clearly explained. Analysis of deaths due to hemorrhage in this series also tends to minimize the traditional rôle of jaundice in this regard. There were five deaths due to massive postoperative hemorrhage, each confirmed at autopsy. Three patients were in the "jaundiced" group but autopsy showed laceration of major vessels in two of these. The site of bleeding could not be found even at autopsy in the third jaundiced case and this was therefore conceivably a death in which the effect of jaundice on the clotting mechanism was extremely important. However, the two remaining "hemorrhage" deaths were in nonjaundiced patients and at autopsy, likewise, the site of bleeding could not be found in one. A major laceration accounted for hemorrhage in the other. If autopsies had not been done, those jaundiced patients, all dying from clinically obvious massive

hemorrhage, would have been described as succumbing to the bleeding "tendency" caused by their obstructive jaundice. Lastly, no bleeding of note was found in any of the remaining six jaundiced patients who came to autopsy, while the twenty-nine jaundiced patients who survived operation showed no bleeding during their hospital courses. (Prothrombin studies were not done.) These facts lead to the conclusion that, at least in this series of cases, jaundice as such was not a death factor of great importance.

### III. THE LIVING SERIES

*A. Complications.* Among the living series, the complications encountered are shown in Table iv. As might be expected, when the pathological condition was more acute and progressive, the percentage of complications was higher.

TABLE IV  
COMPLICATIONS IN LIVING SERIES

	Chronic	Acute	Jaundiced	Total
1. Postoperative wound infection	18	2	2	22
2. Pulmonary				
a. pneumonitis	9	1	3	13
b. pleurisy with fluid	2	0	0	2
c. atelectasis	2	3	0	5
3. Cardiac				
a. decompensation	1	0	0	1
b. auricular flutter	1	0	0	1
4. Urological				
a. cystitis	2	0	0	2
b. pyelitis	1	0	0	1
c. bladder paralysis	0	1	0	1
5. Biliary fistula	2	1	0	3
6. Evisceration	1	0	0	1
7. Subdiaphragmatic condition	1	0	0	1
8. Suppurative parotitis	1	0	0	1
9. Postoperative psychosis	1	1	0	2
10. "Stormy"	1	3	3	7
Complications—per cent	19	25	29	

*B. Follow-up Study.* 1. Table v is a summary of the clinical results obtained by gallbladder surgery among the 302 patients of the "living series." It should be ex-

plained that the terms excellent, good, fair, etc., are entirely subjective evaluations. The justification for their use exists in that a single observer interviewed and examined a great majority of the patients. A uniform standard of values was thereby attained with error of constant nature. The group of "excellent" and "good" results included patients who had, at follow-up clinic, complete or almost complete relief of all the symptoms they complained of before operation. Restoration of a patient's economic status by a good operative result was taken into account. The "poor results" group included those patients who had many and sometimes all of the symptoms that were present before operation. Table v indicates that improvement followed operation in most instances. The mortality rate was parallel to the degree of improvement in each group, that is, the higher the mortality rate the better were the results in those patients who survived.

2. *Analysis of the Poorer Results.* During the interviews, the impression was obtained that most of the poor results are associated with less definite or minimal disorders. This led to a comparative study of the conditions found in the two major groups, that is, the group of "excellent and good" results and that of "poor" results. The study was based on the reports of the gross and histological pathological status and on the x-ray studies of the gallbladder by cholecystogram. The pathological changes were classified as "definite" and "minimal." The latter included minimal stages of gallbladder disease with thin walls, few or no stones and minimal microscopic findings. It was found that in the group of patients with "excellent—good" results, only 5 per cent had "minimal" gallbladder disorders, while 65 per cent in the group of patients with poorer results had minimal changes. Minimal findings were also present in eleven other cases for which no follow-up report was available. On an x-ray basis, a similar distinction was made between cases having what were called "definite" and those having "indefi-

TABLE V  
RESULTS

Type	Survived	Excellent—Good		Fair		Poor		Mortality Rate, Per Cent
		No. Cases	Per Cent of Patients Returned	No. Cases	Per Cent of Patients Returned	No. Cases	Per Cent of Patients Returned	
Chronic no jaundice	229	145	86	10	6	13	8	4 9
Acute no jaundice	44	37	100	0		0		21 4
Jaundice at operation	29	24	100	0		0		27 5

nite" findings. By "indefinite" is meant that group which even in the presence of one or more stones, nevertheless showed some gallbladder function. These x-ray reports read "good concentration with poor emptying" or "stone—no impairment of function" or "good emptying—slow filling" or "only slight impairment of gallbladder function." Classed as "definite" were those cases showing absent gallbladder function, with or without visualization of stones. It must be emphasized here that in this study the presence of gallbladder disease of some degree was accurately revealed by the x-ray in over 97 per cent of the cases and that this division of x-ray reports into "definite" was a purely arbitrary one made in the attempt to understand the poor results. The "indefinite" x-ray diagnosis was much more common in the group of "poorer" results.

Both these demonstrations of the effect of minimal changes in morphology and function were confirmed in the more detailed study of thirteen cases in which the results were classed "very poor." In this group, ten of the thirteen patients had "minimal" findings reported and nine of eleven had the "indefinite" type of x-ray report. The presumption exists that the basic cause for the poor results is found in the failure to remove the disease process causing the symptoms. Carter et al.<sup>1</sup> arrived at this identical conclusion.

3. The rôle of cholelithiasis in the results is shown in Table VI. While the death rate and the complication rate were slightly

higher in those patients having stones, the results were definitely better once the patient survived.

TABLE VI  
RÔLE OF CHOLELITHIASIS IN RESULTS

	No Stones 90%, Per Cent	Stones 10%, Per Cent
Death rate	6 8	10 4
Complication rate	13 0	19 0
Results (per cent of total cases)		
a. No trace	34 0	20 0
b. Excellent—good	46 0	64 0
c. Fair	3 0	3 0
d. Poor	6 0	1 3
e. Very poor	3 0	3

C. "Early" versus "Late" Operation in Acute Gallbladder Disease. There has been much written concerning early versus late operation in the acutely inflamed gallbladder. Pleas have been made for both "early" and "late" surgery. In this study, instead of choosing an arbitrary time limit as to what should be called "early" or "late" operation, the acute cases were divided into two groups depending upon the reason for operation. (Table VII.) Group 2, consisting of thirty-two cases, happened to include patients operated upon from the seventh to seventy-seventh hospital days, with normal temperature, when the acute process was considered to have subsided enough to make operation safe. Group 1 included twenty-eight patients operated upon between the first and fifth hospital days, usually because of

mistaken diagnosis (sixteen cases). These, with four patients operated upon because of an acute condition of the gallbladder requiring intervention and eight others operated upon because of continuing fever and jaundice, served as an effective control "early" group with which to compare the results of "late" operations. Table VII shows that the earlier group had a much higher death rate, with not much difference as to whether cholecystectomy or cholecystostomy had been done. If the patients survived, however, end results in both "early" and "late" groups were about the same. Carter et al. give as their experience the best results in the group "early" surgery, not exceeding twenty-four hours.

TABLE VII  
TIME OF OPERATION VERSUS RESULTS ALL ACUTE CASES

		Cases
1. Group one (1-5th day).....	Operated because of	28
	a. Mistaken diagnosis.....	16
	b. Acute condition.....	4
	c. Continuing fever or jaundice.....	8
2. Group two (7-77th day).....	Operated because of normal temperature (cholecystostomy).....	36 12

	Group One, Per Cent	Group Two, Per Cent
Death rate.....	32	13
Cholecystectomy.....	30	4
Cholecystostomy.....	33	33
Survivals		
a. Complication rate....	26	25
Cholecystectomy.....	16	16
Cholecystostomy.....	10	9
b. Good results.....	93	83

Attention is drawn to the fact that in Group 2, which includes all patients with normal temperatures, ostensibly "cooled off," the condition was nevertheless sufficiently severe and acute to require cholecystostomy in twelve of thirty-six cases, with attendant higher mortality. This leads to one of the most instructive facts revealed by this study, namely, that these cases of acute cholecystitis, although subsiding, had not been allowed to subside enough, even though seventy-seven days

had passed in the longest case. All of this group were reported as acute by the pathologist or surgeon. This indicates that it would be preferable, once the temperature has become normal, to allow a longer interval, several months, for complete subsidence under careful supervision. Acute cases would thus fall properly into the group of "chronic gallbladder disease without jaundice," with its lower mortality rate. Should an acute flare-up again occur the case could then be treated as an acute attack in whatever way thought best.

*D. Gallbladder Disease in the Male.* Comparison of the males and females throughout all phases of the study showed that male patients were generally older, they developed the severe acute type of disease more often and their complication and mortality rates were higher. Operative relief was obtained in about equal proportions in both sexes.

*E. Problems in Differential Diagnosis.* One of the most significant aspects of this surgical study is found in the problems of differential diagnosis encountered.

The carcinomas of the gallbladder and the pancreas numbered thirty. These led to confusion mainly because of the occurrence of obstructive lesions of the common duct. An interesting feature of this group, however, was the existence of advanced disease before obstruction appeared. The patient usually exhibited marked weight loss, large liver and multiple palpable abdominal masses, all of which were found very rarely in the entire surgical group in this study.

The diagnosis of acute appendicitis was erroneously considered eleven times and prompted emergency surgery for appendicitis six times. One case was diagnosed acute cholecystitis and was found to have a ruptured appendix at autopsy.

The clinical picture of *chronic* cholecystitis and cholelithiasis with the finding of advanced severe *acute* condition of the gallbladder at operation occurred five times. In each instance, the patient had a normal temperature. This parallels the finding already stressed of the high inci-

dence of acute, severe, inflammatory disease in patients operated upon after considerable periods of observation in the hospital for supposed complete subsidence of an acute attack. Mentzer<sup>2</sup> stressed this same masquerading of acute gallbladder disorders under various guises. The converse picture of acute disease clinically with the findings at operation of chronic disease occurred only once in our series.

A pathological condition of the right kidney was considered in ten cases to the extent of retrograde urography in seven. Two patients actually turned out to have renal disease and in one it was the only cause of the patient's symptoms. This association has been recently emphasized by Derrah and Kaufman.<sup>3</sup>

Among problems less frequently encountered, chronic peptic ulcer occurred three times. It is of interest that chronic ulcer was palpated at operation in two instances in the entire series. Acute pancreatitis, angina pectoris, coronary occlusion, carcinoma of the stomach, lobar pneumonia, arsenical hepatitis, incarcerated hernia and right diaphragmatic pleurisy cover the range of other conditions considered before operation.

#### IV. A GROUP OF INTERESTING CASES

CASE I. This patient was a seven-year old, white male who was admitted to the Contagious Disease Pavilion of the hospital with the typical history and findings of scarlet fever. On the third hospital day, abdominal pain and tenderness over McBurney's point led to the diagnosis of acute retrocecal appendicitis. At operation, an acute empyema of the gallbladder was found with impending gangrene. No stones were present. A cholecystostomy was done and the patient had an uneventful postoperative course.

CASE II. This patient was a forty-one year old, white male, who died on the medical ward after a short illness of about three weeks, with the classical history, physical findings and laboratory evidence of typhoid fever. At autopsy, in addition to typhoid ulcers of the bowel, the gallbladder was the seat of phlegmonous cholecystitis without stones, confirmed by microscopic examination.

CASE III. This patient was a forty-two year old, white female admitted for intense jaundice of five days' duration and severe colicky, right upper quadrant pain radiating to the back and right shoulder. At operation, the common duct was found to have been completely obstructed by multiple echinococcal cysts measuring 2 to 3 cm. in diameter. The parasitic nature of these cysts was confirmed microscopically by the finding of typical hooklets and scolices. Postoperatively, the patient continued to discharge smaller cysts through her T tube. She signed out at her own risk in poor condition, was reoperated upon at another hospital and died. No autopsy was obtained.

CASE IV. This patient was a fifty-nine year old white male, who had an exploratory laparotomy for intense jaundice of several weeks' duration. The patient had a steadily downhill postoperative course. Postmortem examination revealed a scirrhous carcinoma of the body of the pancreas. Normal pancreatic tissue intervened between the tumor and the common duct. The latter, however, was the site of an independent primary carcinoma, which had produced complete obstruction.

CASE V AND VI. These are two cases of bronchial asthma in which marked and dramatic but only temporary relief from asthmatic attacks was noted following the removal of chronically infected gallbladders.

CASE VII. Finally, there is mentioned the case of a sixty-two year old, white female, who had what was supposed to have been a cholecystectomy twenty years previously. She was admitted with a large herniating mass in the region of her operative scar thought to be incarcerated bowel. Operation revealed the hernial sac to be completely filled by a tremendously dilated, chronically infected gallbladder containing many stones.

#### SUMMARY

Five years of gallbladder disease at a general hospital were reviewed with a study of 337 surgical cases.

1. The mortality rate is lowest in the "chronic without jaundice" group and highest in those patients jaundiced at the time of operation.

2. Those cases in which death occurred were, in general, of an emergency nature.

3. The causes of death may be summarized briefly: (a) The cardiac factor was

important in nine deaths; (b) the accidental factor was important in ten deaths; (c) other concomitant serious pathological conditions were important in three deaths; (d) acute severe conditions of the gallbladder accounted for seven deaths and perforation played an important part; (e) the chronicity of the disease contributed to the death total by causing acute pancreatitis, marked hepatitis and jaundice; (f) jaundice was not an important death factor in this series; and (g) gallbladder disease as such accounted for death most frequently in the acute type of case.

4. Results in general were good. Poor results were associated with less definite findings, both pathologically and by x-ray.

5. In acute cases, "early" operations were attended by a higher mortality rate than "late" ones.

6. Many gallbladders, "cooled off" and thought to have subsided, still showed acute conditions at operation.

7. The male patient was usually older and had the more acute type of disease, with higher complication and mortality rates than the female.

8. Some problems in differential diagnosis are discussed.

9. A group of unusual cases is presented.

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# FIVE YEARS OF GALLBLADDER DISEASE AT AUTOPSY IN A GENERAL HOSPITAL\*

## A REVIEW OF 2,450 CONSECUTIVE ROUTINE AUTOPSIES

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THE object of this study was to note the incidence and nature of gallbladder disease as found in a large series of consecutive routine autopsies at a general hospital. The bed capacity of Queens General Hospital is 700 and the average hospital stay is nine days. Annually, the autopsy percentage has been consistently over 58 per cent and as high as 66 per cent, with an average of 500 house autopsies done each year.

### I. INCIDENCE OF GALLBLADDER DISEASE IN ROUTINE AUTOPSIES

Medical literature contains many studies done in the past noting the incidence of gallstones among routine autopsies. (Table 1.) In the present study (Table II), the total number of routine autopsies was 2,450, covering a five-year period between November, 1935, and November, 1940. Cases of cholecystitis with or without cholelithiasis numbered 271. The gross incidence for the entire series was 11 per cent. Corrections for age groups are also shown in Table II. The rising incidence in older subjects is noteworthy. One in every five patients over sixty years of age was found to have cholecystitis or cholelithiasis, regardless of the cause of death.

### II. THE PATHOLOGICAL CONDITIONS ENCOUNTERED IN THE GALLBLADDER

Gross and microscopic criteria were used. Microscopic examinations had not been done in all of the routine cases, when the gallbladder appeared "normal," or had obvious gross disease. One hundred con-

TABLE I  
INCIDENCE OF GALLSTONES IN ROUTINE AUTOPSIES

Author	No of Autopsies	Per Cent Incidence
Munich (Ritter)	19,974	7 8
Petrograd (Hesse)	17,402	2 1
Basle (Roth)	16,025	10 7
London (Ticehurst)	11,133	3 0
Copenhagen (Paulsen)	9,172	3 8
Japan (Miyake)	8,406	3 0
Kiel (Peters)	5,962	2 7
London (Rolleston)	4,616	5 8
Calcutta (Rogers)	4,544	5 3
Dresden (Fiedler)	4,300	6 3
London (Walton)	3,775	3 4
Sweden (Scheel)	2,753	15 0
New York (Hertes)	2,371	7 6
Göttingen (Hunerhoff)	1,951	4 4
Albany (Stanton)	1,667	7 2
Baltimore (Mosher)	1,665	6 9
Chicago (Mitchell)	1,600	3 1
Manchester (Brockbank)	1,347	7 4
Strasbourg (Shroeder)	1,150	1 2
Panama (Clark)	1,088	2 2
Tomsk (Hesse)	1,000	2 1
Toronto (Ryerson)	333	4 0

#### Recent Reviews

Mentzer (Mayo Clinic) 1926	612	21 0
Crump (Vienna) 1931	1,000	32 0
Ludlow (Cleveland) 1937	4,800	7 0

secutive cases current during 1940 were studied to serve as a control group. Four gallbladders grossly "normal" showed some degree of round cell infiltration on microscopic study. Two of these, in addition, had moderate interstitial fibrosis. In ninety-six cases, a gross diagnosis of "normal gallbladder" was confirmed microscopically.

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Findings in the gallbladder fell easily into two major groups: The first including only uncomplicated cholecystitis with or without stone totalled 271 cases. In the second group were all other types of gallbladder conditions not considered in the calculation of the 11 per cent incidence.

TABLE II  
INCIDENCE OF CHOLECYSTITIS IN 2,450 ROUTINE AUTOPSIES AT QUEENS GENERAL HOSPITAL

Age Group	No. of Cases	Cases of Gall-bladder Disease	Per Cent Incidence
All ages	2450	271	11 0
Under 2 yrs	340	0	0 0
2-10 "	98	0	0 0
10-20 "	95	2	2 0
20-30 "	176	7	4 2
30-40 "	220	13	6 3
40-50 "	343	38	11 0
50-60 "	450	59	13 5
60-70 "	412	79	19 0
70-80 "	257	58	22 0
80-90 "	58	15	25 0

Age Group	Per Cent Incidence
All patients over 40 yrs	15 0
" " " 50 "	18 0
" " " 60 "	20 0
" " " 70 "	22 0
" " " 80 "	26 0

In the first group (cholecystitis with or without stones), the extent of inflammatory involvement of the gallbladder was found variable but permitted of further subdivision into three principal subgroups: (a) severe involvement (acute and chronic); (b) moderately advanced involvement and (c) minimal involvement. These three types were about equally distributed among the various age groups. (Fig. 1.)

(a) The severe acute disease encountered varied from diffuse exudative cholecystitis to empyema of the gallbladder with perforation. There were fourteen such cases, eight males and six females. Although this is a small series, this finding differs from the

generally accepted idea that severe acute gallbladder disease is more common in the female. Nine of these fourteen severe acute cases had progressed to empyema of the gallbladder, each with associated cholelithiasis. Perforation occurred in seven of the nine empyemas and was directly responsible for death in five cases. Regional abscesses, multiple fistula formation and generalized peritonitis followed perforations and accounted for these mortalities. The remaining two patients with perforation died of sepsis from other causes (infected leg varicosity and ruptured colonic diverticulum). The two patients with unperforated empyema died nevertheless of their gallbladder disease with sepsis an important factor.

Acute inflammatory changes other than empyema included an acute diffuse exudative cholecystitis in a patient who died of subacute nephritis, an instance of focal suppuration in a chronically inflamed gallbladder wall, two cases of acute phlegmonous cholecystitis in postabortal and genitourinary sepsis and one case of gangrenous cholecystitis in a patient who died of fulminating typhoid fever. The occurrence of diffuse exudative cholecystitis in sepsis is of considerable theoretical as well as practical interest. Seeding of bacteria from the blood stream into the gallbladder walls, with subsequent progressive acute inflammation is strongly suggested. Seven of the fourteen patients with the severe acute type of gallbladder disease succumbed to it. The others died of various other causes.

Severe chronic inflammatory changes were present in fifty-six instances. Thirty-seven of these presented marked contraction and thickening of the gallbladder wall, with many stones but no obstructive condition in the biliary ducts. There were, in addition, fifteen cases of hydrops of the gallbladder, with chronically thickened walls, clear fluid, impacted calculi in the cystic duct and little other contiguous change. Only one death in this entire group of fifty-six cases could be attributed

directly to a pathological condition of the gallbladder.

(b) *Moderately advanced pathological changes* were found in forty-five instances.

and seven of the 156 minimal disease group had a positive history. Symptoms varied from slight belching after meals to severe attacks of right upper quadrant pain.

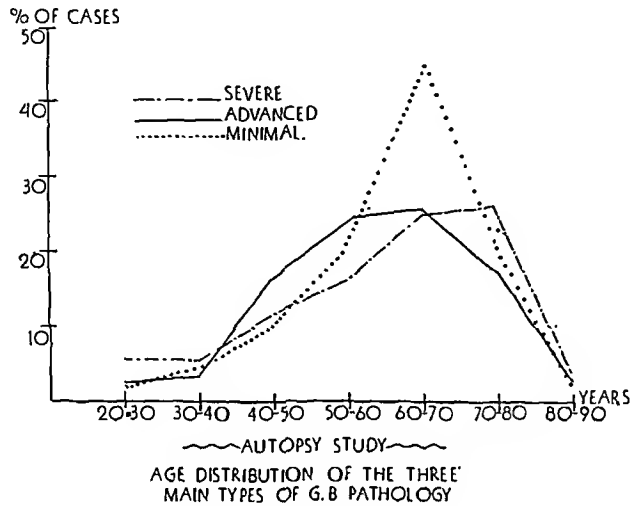


FIG. 1.

Here the gross changes were less marked than in the "severe" type, with less thickening of the walls, fewer stones and usually intact mucosa. Microscopically, there was definite but not marked round cell infiltration and fibrosis. Males numbered twenty, females twenty-five, in this group and cholelithiasis was present in 80 per cent of cases. None of these patients died of his gallbladder disease.

(c) *Minimal pathological changes* were found in 156 instances, the great majority. Here females outnumbered males, ninety-five to sixty-one. Cholelithiasis was present in 80 per cent of cases. Minimal thickening of the wall with intact mucosa and only one or more small stones were usually present. No deaths were attributable to gallbladder disease in this group.

#### CLINICAL CORRELATION

A positive history of recognizable symptoms referable to the gallbladder was elicited in only thirteen of the 271 cases found to have gallbladder disease at autopsy (4 per cent). Only five of the seventy cases of severe disease, one of the forty-five moderately advanced cases

Non-inflammatory changes in the gallbladder, not included in the 11 per cent incidence, composed the *second major group* which included the following: Carcinoma of the gallbladder was found eight times and was associated with cholelithiasis four times. Cholesterolosis was present in sixteen cases. Miscellaneous conditions included leukemic infiltration (two), mucosal polyps (three), acute "uremic" ulceration (one), adenomyoma (two), marked edema of the entire wall in chronic passive congestion (two), metastatic carcinoma (two) and miliary tuberculosis (one).

#### III. ASSOCIATED PATHOLOGICAL CONDITIONS ENCOUNTERED

Obstruction by stone was the most frequent *biliary duct* lesion associated with cholecystitis. In the common bile duct, this occurred in nine instances. In the cystic duct, it occurred in fifteen cases of hydrops and in nine cases of acute empyema of the gallbladder.

Abnormal dilatation of the common bile duct was found in ten cases. In four of these, cholecystectomy had been done, and cholelithiasis was present in six. This

dilatation may have represented the effects of stones previously passed.

Postinflammatory stricture of the common duct was noted in two cases.

Carcinomatous obstructions of the biliary ducts were numerous, but the great majority were not associated with intrinsic gallbladder disease. The common hepatic duct was the seat of primary carcinoma in three and the right hepatic duct in one. Common bile duct obstruction by cancer occurred twenty-eight times, with primary sites in the pancreas (twenty-two); in the prostate (one); in the gallbladder (three) and in the rectum (one) and stomach (one). Only one case of primary carcinoma of the common duct was found. It is to be emphasized that the obstruction of the common duct was due to actual invasion of the duct wall in almost every instance. Direct extension of tumor tissue from adjacent lesions resulted in annular stenosing constrictions of the common duct or in an obstructive intraductal lesion, often with ulceration of the duct mucosa. Rarely was compression of the duct by surrounding tumor tissue the mechanism of obstructive jaundice in these cases.

The *liver* lesions encountered in the group of patients with gallbladder disease were seen to be of a type predominantly unrelated to gallbladder disorders. *Biliary cirrhosis* was seen only five times in the entire series of 271 cases, an incidence of 2 per cent. It occurred only in the severe disease group, associated with severe acute inflammation in three cases. In the moderately advanced and minimal disease groups it did not appear at all. There were two cases of obstructing malignancy in the common duct, however, which did have accompanying marked biliary cirrhosis. The "Laennec" type of cirrhosis was found, independently, much more frequently throughout the series. *Cholangitis* occurred only ten times in the entire series (3.8 per cent). Five cases of severe acute gallbladder disease and three of severe chronic type had associated cholangitis. There was no cholangitis in the moderately

advanced pathological group. In two instances of minimal gallbladder disease, cholangitis was present. One of these patients died of meningitis, the other of malignant obstruction of the common duct. Cholangitis was seen to be of more marked degree when obstructive jaundice was present, which occurred in five of the ten cases.

Some of the other liver lesions encountered in these 271 patients with gallbladder disease were; chronic passive congestion, five; fatty change, thirty-four; round cell infiltration into portal areas, twenty-nine; of marked degree, three; metastatic carcinoma, all sources, twenty-six; fibrosis, nineteen; marked, one; Laennec's cirrhosis, twenty-two; bile stasis with jaundice, eight; multiple abscesses, seven; diffuse hepatitis, five (not gallbladder cases); focal necrosis in presence of sepsis, five; miscellaneous lesions including hemangioma, miliary tuberculosis, hepatoma and Hodgkin's disease.

Lesions of the *pancreas* as of the liver did not seem to be significantly related to gallbladder disease in this autopsy series. "Interstitial fibrosis" was the most common lesion, occurring forty-three times, but was of marked degree only five times. There was no demonstrable relationship between the severity of the gallbladder disease and the degree of fibrosis. Chronic pancreatitis was observed in nine instances, 4 per cent. Severe gallbladder disease was present in five of these. Acute pancreatitis was observed in only one case of gallbladder disease, classed "severe." It was seen once each in a case of carcinoma of the common hepatic duct and in a carcinoma of the gallbladder neck with impacted cystic duct stone.

Disease of the *appendix* showed no demonstrable relationship to gallbladder disease. Previous appendectomy was noted sixteen times. Ruptured appendix causing fatal peritonitis occurred in three cases. Appendiceal fibrosis was observed in three cases and mucocoele of the appendix in one.

## IV. THE RELATIONSHIP OF GALLBLADDER DISEASE TO ARTERIOSCLEROSIS

There has been much written concerning the difficulty often met in distinguishing an acute gallbladder attack from an acute coronary occlusion or spasm. The material here reviewed offered an excellent oppor-

was noted. The results are tabulated in Table III. "Marked changes" include widespread atheromatous involvement of calcification, and in the coronaries, any recent or old occlusion. In the interpretation of "moderate" changes, the personal equation of the pathologist entered, but this entire series of autopsies was done

TABLE III  
ARTERIOSCLEROSIS STUDY

Patients with Marked Coronary Sclerosis			Patients with Gallbladder Disease	
Age	Patients without Gallbladder Disease, Per Cent	Patients with Gallbladder Disease, Per Cent	Degree of Gallbladder Disease	Per Cent Marked Coronary Sclerosis, Per Cent
Over 50.....	28	30	Severe.....	30
Under 50.....	18	5	Moderate.....	20
			Minimal.....	20

Table in Full

271 Patients with Gallbladder Disease (All Ages)					1045 Patients without Gallbladder Disease (All Ages)			
	Coronary, Per Cent	Kidney, Per Cent	Cerebral, Per Cent	Aorta, Per Cent	Coronary, Per Cent	Kidney, Per Cent	Cerebral, Per Cent	Aorta, Per Cent
Over 50 (214)					(910)			
Marked	30	6	21	21	28	6	16	21
Moderate	28	32	18	18	24	9	20	39
Minimal	42	62	61	69	48	85	64	40
Under 50 (57)					(135)			
Marked	5	3	3	8	18	5	12	16
Moderate	18	17	3	18	28	15	15	37
Minimal	77	80	94	74	54	80	73	47

tunity for investigation of the association between arteriosclerosis and gallbladder disease on a firm pathological basis. For this purpose, patients *with* gallbladder disease and patients in similar age groups *without* gallbladder disease were compared. A study was made of the arteries in the 271 cases of gallbladder disease and in a large control group of 1,045 patients. The degree of arteriosclerotic change in the coronary, renal and cerebral vessels and in the aorta

under uniform supervision and the number was large enough so that the margin of error is small. The renal lesions were interpreted mainly on microscopic grounds. Lesions taken to be of the greatest significance were those in the coronary arteries.

The conclusion arrived at as a result of this study was that arteriosclerosis generally and marked coronary disease specifically are not more common or present in severer degree in patients with gallbladder

disease. Confirmatory evidence was found in that deaths of a vascular type, namely, those due to arteriosclerotic gangrene of the extremities without diabetes, arteriosclerotic heart disease with failure, cerebral hemorrhage and directly allied conditions were not more common in the group with gallbladder disease than in the control group.

These findings coincide with those of Tennant and Zimmerman<sup>4</sup> who analyzed 1,600 consecutive autopsies. They concluded that "there is no significant association in the occurrence of gallbladder disease and arteriosclerotic heart disease in an age period in which most of the instances of each lie."

#### SUMMARY

Gallbladder disease in 2,450 consecutive autopsies during a five-year period at a general hospital were reviewed:

1. "Incidental" gallbladder disease with stone was found in 271 cases (11 per cent). With each decade this figure increased, reaching 25 per cent in the eighth decade. Symptoms referable to the gallbladder had been elicited in only 4 per cent of cases.

2. Seventy (25 per cent) of the 271 cases of gallbladder disease were "severe" in degree. Severe, acute pathological conditions accounted for the highest percentage of "gallbladder deaths," and perforation played a predominant rôle. Severe chronic disease was manifested principally by cases of hydrops of the gallbladder and of marked contracted chronic cholecystitis and cholelithiasis. Only one death was due to "gallbladder disease" in this group. Only five of seventy patients who showed severe

gallbladder disease at autopsy showed any clinical symptoms referable to the gallbladder.

3. Moderately advanced and minimal gallbladder conditions comprised 16 per cent and 59 per cent, respectively, of the entire series and accounted for no deaths.

4. Obstruction by stone was the most common lesion of the biliary ducts associated with cholecystitis in this series. The "invasion" mechanism of carcinomatous obstructive jaundice is emphasized.

5. Inflammation of the gallbladder gave rise to few instances of liver disease in this series. Biliary cirrhosis and cholangitis occurred in a relatively small number of cases.

6. Pancreatic disease resulting from acute or chronic gallbladder disease was not found frequently.

7. No appendiceal abnormality of any significance in relation to gallbladder disease was found.

8. Coronary sclerosis and general arteriosclerosis are not significantly more common among patients with gallbladder disease.

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# THE IMPONDERABLES IN GENITOURINARY CARCINOMA

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**D**URING the past two years I have seen three patients originally suffering from genitourinary carcinoma, whom I believed to be dying of the primary carcinoma or its metastases. They looked cachectic, had lost much weight, had grave, unbearable pain and had every appearance of an early demise. All these patients had intraspinal absolute alcohol injections to control their pain.

All three of these patients are comparatively well now. Two have survived approximately five years after first seen, and I believe have no malignant disease. The remaining one is still in the doubtful class as far as final control of his disease is concerned. The history of these three cases is as follows:

## CASE REPORTS

**CASE 1.** A. F. W., age twenty-four years, was admitted to the Memorial Hospital on November 30, 1937, with the following history: Two months prior to entry he noticed a painless swelling of the left testicle. An Aschheim-Zondek test at that time was negative. The patient was given thirty x-ray treatments to the testicle and the left quadrant. The testicular tumor increased somewhat after these treatments. The patient had a dull pain in the left lower quadrant. He lost about ten pounds in weight within a month.

Physical examination revealed a sharp x-ray reaction to the skin on the lower quadrant. The right testicle was atrophic and the left testicle the size of a large lemon. The skin of the scrotum was desquamating. The Aschheim-Zondek test was again done and this time showed 500 prolan A and 100 prolan B. Later the prolan B increased to 200. There were masses felt in his abdomen and left supraclavicular region. A film of his lungs was not taken at this time. Following this x-ray therapy was given between December 16, 1937, and January 21, 1938. He received 1,500 R to the left testicle at a distance of 50 cm., 1,800 R

at a distance of 70 cm. was given to each of four portals of entry: left lower quadrant anterior, left lower quadrant posterior, left upper quadrant anterior, left upper quadrant posterior. This had no effect on the size of the testicular tumor. An orchidectomy was done on February 3, 1938, under spinal anesthesia.

The pathological examination of the tumor showed embryonal adenocarcinoma Grade III. The testicle was partially necrotic but there was much fully viable disease. On April 27, 1938, there was observed a left supraclavicular gland metastasis. A picture of his lungs at this time showed no metastases. His left lower neck and his upper and lower mediastinum were given deep x-ray therapy. On June 28, 1938, he complained of severe pain along the course of the right sacral nerve and was believed to have metastasis here. The right sacral nerve was treated with deep x-ray therapy 1,200 R anteriorly and 1,200 R posteriorly with portals anterior and posterior at a distance of 50 cm. This treatment did not affect his pain and he began to take codeine. He had lost a good deal of weight and was considered to be in a serious condition. He finally was taking about  $\frac{1}{4}$  gr. every four or five hours for pain relief. His weight was about 135 pounds. He looked very badly, cachectic and it seemed as if he were soon to succumb from his disease. Because of his pain he was given cobra venom injections and he received twenty-one injections of 1 cc. each between February 16, 1939, and March 15, 1939. This gave him some relief but on the whole was ineffective.

His main symptoms were severe pain along the course of the right sacral nerve, general cachexia and great loss of weight. He was given an intraspinal alcohol injection of 12 m. between the last dorsal and first lumbar vertebra. His pain disappeared almost immediately. On June 27, 1939, he reported a gain of some forty-five pounds in weight, he had no pain and had returned to work. On October 26, 1939, he had gained fifty-nine pounds in weight. There was some thickness of the left supraclavicular area. In February, 1942, his

condition was excellent; there was no sign of disease and the patient was working.

*Comment.* This patient's symptoms were apparently due to pressure upon the left sciatic nerve by tumor which was being changed by deep roentgen therapy into scar tissue. His pain and the sedatives he had to take in the attempt to control the pain gave him every appearance of carcinomatous cachexia. I believe he would have died if his pain had not been controlled.

CASE II. J. S. was first seen at the Memorial Hospital on May 12, 1937, with a history of one and one-half years of profuse hematuria without pain. On September 1, 1936, a tumor of the bladder was removed in an outside hospital. Following this he had some x-ray treatment. Six weeks before he was seen he began to have terminal hematuria with urgency, frequency, pain and nocturia but no incontinence. The patient had lost thirty pounds. Cystoscopy showed a large flat ulcerated tumor, very extensive on the left side of the bladder base and the lower left lateral wall. The specimen removed showed "epidermoid carcinoma Grade III." The tumor was considered too extensive for suprapubic implantation of radon seeds. On May 13, 1937, he was treated by surface application of unscreened radium through the cystoscope receiving 749 millicurie hours. He had 20 to 30 cc. residual urine. His condition improved considerably. The radium application caused a good deal of superficial slough of the tumor. He developed a duodenal ulcer and on May 27, 1938, and had a posterior gastroenterostomy from which he recovered. On September 23, 1938, he had a good deal of bladder pain and dysuria, much slough and calcareous material was washed from his bladder. On February 21, 1939, rectal examination revealed much induration of the bladder base and he still had an extensive infiltrating tumor. He was put on deep x-ray therapy and from February 21, 1939, to April 27, 1939, he received 1,600 R to four portals of entry: left anterior pelvis, left pelvis posterior, right pelvis anterior, right pelvis posterior, at a distance of 70 cm. from a portal of 11 by 14 cm. From June 27, 1939, to July 13, 1939, he received 450 R to four portals at a distance of 50 cm. From August 15, 1939, to September 23, 1939, he received to each of two portals anterior and posterior 1,000 R at a distance of

50 cm. On March 7, 1939, he had a great increase of bladder spasm and pain. For this pain between March 10, 1939, and March 22, 1939, he was given ten injections of 1 cc. each of cobra venom. This did him little good.

On March 23, 1939, he entered the hospital and was given an intraspinal injection of 12 m. of absolute alcohol. The patient was placed on the left side and the injection given between the last lumbar and first dorsal vertebra. His pain stopped almost immediately. He gained markedly in weight. There was almost complete absence of pain for six months after the alcohol injection. He still had a moderate amount of hematuria and some dysuria, but it was not enough to indicate another alcohol injection. On June 28, 1940, the patient was in excellent shape; there was some incontinence particularly at night, moderate urinary frequency and a lack of sphincter control when the patient was on his feet. He had gained weight. In January 1942, he was free of pain but had urinary frequency. No tumor could be detected through the cystoscope. He had several areas of white slough in the bladder.

*Comment.* This patient apparently was dying from his carcinoma during the course of treatment by radiation therapy. Alleviation of his pain turned the tables and gave the radiation therapy a chance to complete its control.

CASE III. H. L. L., age sixty-five years, was admitted to the Memorial Hospital on October 21, 1940, with a history of having had a bladder carcinoma, which had been treated at another hospital six months before by means of suprapubic implantation of radon seeds. Subsequent to this he was confined to bed. He had lost a large amount of weight. He looked cachectic. The patient was passing some of his urine through the suprapubic opening and was constantly dribbling the remainder through his urethra. The suprapubic area was widely indurated either from infection or from carcinoma, I could not tell which. Rectal examination revealed massive periprostatic induration which likewise was either caused by extensive tumor growth beyond the bladder or inflammation. Under spinal anesthesia he was cystoscoped. The bladder was filled with white slough. With the stone evacuator very large quantities of slough covered with calcareous deposits were removed from his bladder. His suprapubic wound healed completely in two

days. His incontinence ceased but he had a great deal of pain in urinating. On November 20, 1940, intraspinal alcohol injection of 12 m. was given between the last dorsal and first lumbar vertebra in the right side. On November 25, 1940, as the first injection had not entirely controlled his pain, the second injection of 14 m. of alcohol was intraspinaly injected on the left side. This entirely controlled his pain. He began immediately to improve, got out of bed and went home. By February, 1942, he had gained about twenty pounds in weight and looked well. His urine was cloudy with pus. He was incontinent by day. His periprostatic induration had almost disappeared. He had had no hematuria and I believe his bladder carcinoma has been controlled.

*Comment.* This patient obviously was suffering from massive slough formation and infection. Removal of the slough and controlling his pain gave him a chance to get well.

These three cases are in the class of imponderables in genitourinary carcinoma. With just a shade of casualness in estimating the real underlying cause of their condition, with the usual methods of combating their pain, morphine, etc., all three might easily have died not of their carcinoma but of attendant and unexpected complications. If the patients' pain had not been controlled by the intraspinal alcohol injections, two of them, I believe, would surely have died.

The explanation of the recovery of the third patient is comparatively simple. He had massive slough and stone formation of his bladder caused by radium implants. These caused severe infection of his urinary tract. Removing the stones from his bladder controlled the infection.

The explanation of the recovery of the two other patients is not as simple. The patient with teratoma testis must have had perineural metastasis as a cause of his pain. His pain alone was causing his physical deterioration and I believe would have caused his death. His subsequent rapid recovery when his pain ceased, his all around physical improvement gave the roentgen therapy, which he previously

had, a chance to complete its ultimate destruction of the metastatic teratoma.

This perhaps implicates a new and previously unsuspected principle in the treatment of intractable and extensive carcinoma. Deep x-ray therapy has proved singularly inadequate in controlling many body cancers in spite of the persistent endeavors of the best cancer-minded physicians of the entire world. It has been so nearly adequate and yet it has failed.

I think everyone agrees that the obliterating endarteritis in the tumor vessels caused by deep x-ray treatment is a much more important effect than the primary and early cell destruction. The former is, however, a long distance effect. It takes a long time, months even years.

In most cases the race between the growth of the cancer and the healing x-ray has been a very unequal one. The cancer has nearly always won out. In addition to the cancer growth *per se* causing bodily destruction and finally death we have long known that infection of the cancer and of organs adjacent to the cancer very materially adds to the bodily disintegration. This is especially true in some internal cancers e.g., bladder and cervical cancers. In these two the destructive effect of the infection of the bladder and kidneys may catch up with and pass that of the original cancer.

To this destructive effect of infection must be added in at least some cases the destructive affect of *pain*. This is clearly shown in Cases I and II above reported. The control of pain releases this destructive affect and certainly gives the deep x-ray therapy a longer and more propitious chance to get in its work.

We have had fourteen cases to which we have given intraspinal alcohol injections for the relief of pain. All of these patients have been considered dying of their disease. Two of these patients (Cases I and II) have entirely recovered because of the control of pain.

The study of the control of pain in cancer may cause even revolutionary changes in the treatment of such patients.

# SUTURE DRESSING ANCHOR

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THE present methods of closing wounds of the skin, whether traumatic or operative incisions, have held for

able. No individual has ever looked back with pleasure upon the time that adhesive tape was removed from his skin, particu-

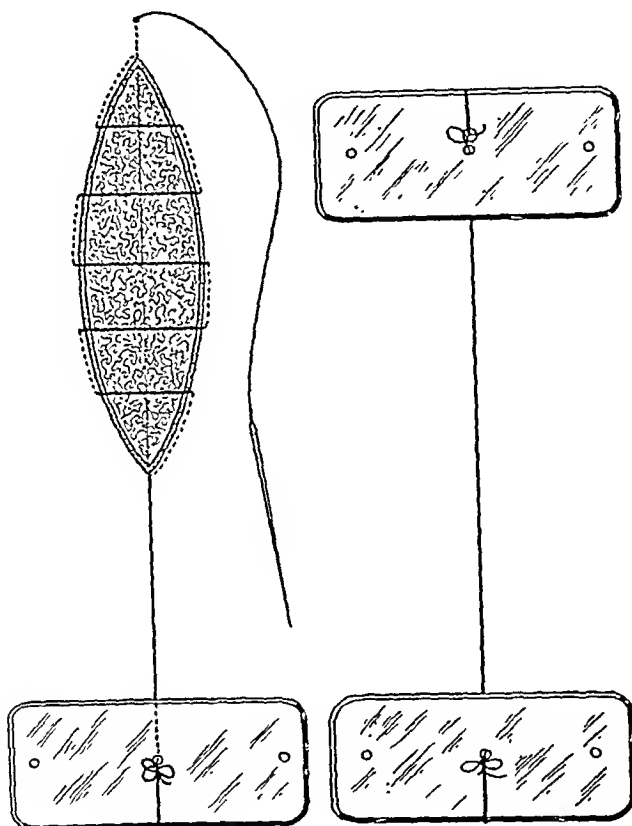


FIG. 1.

FIG. 1. Incision partly closed with a subcuticular stitch. One suture anchor attached in place, with catgut emerging from under skin beyond incision.

FIG. 2.

FIG. 2. Incision closed and both anchors attached in place.

many years and in spite of the means of closure used, not much thought has been given to the objectionable features. Regardless of whether black silk, clips, silk-worm gut, wire or other materials are used, all have certain definite points in their favor as well as objectionable features.

After all types of wounds are closed, the usual practice is to place sterile dressings thereon and then secure these dressings in place by means of adhesive tape. The objections to adhesive tape are innumer-

ably from his abdomen or extremity, taking therewith areas of skin, leaving the tender raw surface exposed to secondary infection. It is always too tight or too loose. It pulls away, denuding the skin under the edges. It is dirty, irritates the skin, itches, or causes blisters and in some persons causes an actual dermatitis in sensitive cases, vesicular or bullous in type.

All in all, a great deal can be said against our present methods of wound closure and protective dressings. With the multiple bad

features constantly in mind, over a period of years I have attempted many devious ways to avoid these very features. Later,



FIG 3 Dressings in place, closed and attached to anchors.

in some 100 cases, I have tried a new device in conjunction with the infrequently used subcuticular stitch, a method whereby the wound is closed, the device attached and the dressings attached in their turn to the device.

Many laudatory features can be enumerated in favor of the use of a well placed subcuticular stitch: (1) The subcuticular stitch prevents the making of multiple punctate openings in the skin surface adjacent to the wound, thus obviating multiple points at which infection may occur. (2) It prevents the common occurrence of puncturing superficial blood vessels with subsequent bleeding. (3) It prevents superficial pressure on the wound from sutures or clips too tightly placed with resultant pressure cuts and edema. (4) It offers better approximation of the skin edges and consequently a better cosmetic

effect. (5) It removes entirely the painful experience entailed in the removal of sutures or clips with a secondary reopening of multiple avenues of infection.

Before explaining the method in detail it will be well to state at this point that the subcuticular stitch of any fine catgut from No. 0 to 00000 is placed and to the free ends of this are attached the suture dressing anchor as shown in Figure 1. To this suture dressing anchor, sterile dressings are attached. (Figs. 1 and 2.) With the dressings fastened to the anchor no adhesive tape is used. The dressing is in place and remains so (Fig. 3.) Because no adhesive tape is used, the patient is spared the objectionable features enumerated previously against adhesive tape; and in any hospital where this method is used, and even in the physician's and surgeon's office, considerable saving results to the hospital or surgeon from the decrease in the use of adhesive tape and closure materials.

The device is made in various sizes and can be used on any external part of the body from the head to the feet. The same device can be used to place tension sutures and do away with silkworm gut and rubber tubing and their often evil aftermath, edema, tension abscesses and skin inflammations.

Present nonabsorbable skin closure materials and dressing securements are wasteful, painful and should be remedied from the viewpoint of patient, surgeon and hospital.

#### METHOD

All wounds are closed in the usual manner until all but the skin is left to be closed. At this point one of the suture dressing anchors is firmly attached to the end of a length of fine catgut. The needle is inserted in the skin about  $\frac{3}{8}$  to  $\frac{1}{2}$  inch from either end of the incision. The usual subcuticular stitch is followed and drawn lightly until the edges are approximated, thus closing the wound, until the opposite end of the incision is reached, at which point the needle emerges through the skin surface about  $\frac{3}{8}$  to  $\frac{1}{2}$  inch from the other

end of the incision. At this point the needle and catgut are passed through the center hole of the other anchor. It is threaded through once or twice and then tied in place. Both knots, therefore, are on the upper surface of the anchor and not between the anchor and the skin. Sterile dressings of the required size are next applied by cutting slits at the top and bottom of the dressing just enough to permit the cut ends to be slipped under the anchor at top and bottom, thus covering the wound entirely and the two very small areas of catgut between the skin and the anchor. With the remainder of the catgut, sutures are taken in the dressing to close the two slit ends extending beyond the anchors, and the dressings in turn are fastened to the two lateral holes in the anchor with catgut. The dressing at this

point may be considered finished if it is a small dressing on the scalp or face, or any other part of the body; if on the abdomen, an abdominal pad and many-tail binder are applied, or if on an extremity a light gauze or muslin bandage.

In this way the outer dressing may be removed at any time without disturbing the sterile dressing or the anchor itself; in fact the sterile dressing also may be removed and a new one placed at any time.

In clean operative wounds I always leave the original dressing untouched and at any time within five to seven days the dressing will detach itself with the anchors still securely fastened to the gauze, due to the subcuticular digestion of the catgut itself, making a clean, closed and better cosmetic wound.



# ABDOMINOPERINEAL OPERATIONS FOR RECTAL AND RECTOSIGMOIDAL CANCER

## NEW MODIFICATION OF MILES' TECHNIC FOR DIFFICULT DISSECTIONS

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**A**BDOMINOPERINEAL resections are the operations of choice for removing rectal and rectosigmoidal cancer. By employing both the abdominal and perineal approach one is able to carry out the widest dissection and provide patients with the greatest possibility of clinical cure. Operations of this nature are ideal for all patients with operable cancers except those in very poor physical condition.

The most satisfactory abdominoperineal operation is the one devised by Miles,<sup>1</sup> of London, in 1907. This operation has stood the test of time and is widely employed today. While there have been a number of improvements in technic since it was originally described, the principles of dissection remain the same. The anus, rectum and lower half of the sigmoid colon are removed, together with adjacent tissues which may contain malignant cells. The patient is left with a permanent abdominal colostomy.

The Miles' operation has been frequently described and need not be repeated in detail. The following is a summary of the more important steps in this operation: The abdomen is opened through a lower left paramedian incision, the rectus muscle being retracted to the left. The abdominal cavity is explored for other tumors of the gastrointestinal tract, extent of the primary tumor, metastatic disease and other abdominal pathological conditions. The dissection is commenced by ligating the inferior mesentery artery; the site of selection is between the first and second sigmoidal arteries. The rectum is freed from the lateral and posterior borders of the pelvis. The lateral leaves of the meso-

sigmoid and mesorectum are divided after a moderate degree of mobilization of the adjacent pelvic peritoneum. Incisions are carried down parallel to the bowel on either side and connected anteriorly to the rectum. Care must be exercised in ligating the vessels and dividing the pelvic peritoneum on the left side, lest an abnormally located left ureter be injured. The rectum is separated from its anterior attachments, namely, the base of the bladder and seminal vesicles in the male, and the posterior vaginal wall in the female. The separation is extended as far as is convenient; usually it reaches the level of the prostate in the male. The abdominal part of the dissection is completed by cutting the lateral ligaments.

Following pelvic dissection, the sigmoid colon is divided. In recent years this procedure has been greatly facilitated by use of the Zachary Cope or other modifications of the De Martel clamp. The distal segment of pelvic colon and upper rectum are placed in the presacral space and the new pelvic floor is constructed. Construction of the pelvic floor is greatly facilitated by liberal mobilization of the pelvic peritoneum. The proximal end of the pelvic colon is brought through the original incision or through a stab wound to form a colostomy. The gut need not be sutured to the left lateral wall nor need it be sutured to the wound. The wound is closed in layers and a dressing applied.

The final step consists of dissecting free the anal canal and lower part of the rectum through a perineal incision. Miles places the patient on the left side for this part of the operation. Some surgeons turn the patient

on his abdomen, while others including ourselves, prefer the lithotomy position. The feet are placed in stirrups and the buttocks drawn down to the end of the table and elevated by means of a sand bag. The anus is closed with a purse-string suture and the operation completed by wide dissection. Seldom is it necessary to remove the coccyx. After the terminal section of bowel has been dissected free and removed, a rubber glove packed with gauze is inserted into the pelvic cavity, the skin closed with two or three superficial sutures and a dressing applied.

Numerous modifications of the Miles' technic have appeared in the current literature. A number of these modifications have been in the form of two-stage procedures, while others have been completed in one stage. In some instances the perineal has preceded the abdominal dissection. Many of the modifications are being less frequently employed because the advantages of the original abdominoperineal procedure are becoming more generally recognized. After a limited experience with a number of different types of abdominoperineal resections, there appear to be three operations or three slightly different forms of technic which are worthy of consideration: First, the Miles' operation, as previously described; this technic being suitable for the majority of patients; second, a slight modification of the Miles' operation, to be described; this modified one-stage technic facilitates the dissection in certain difficult cases; and third, the Lahey two-stage abdominoperineal resection.

The following technic has been employed in our clinic during the past seven years in thirty-two cases in place of the Miles' operation as described above. The chief difference in the two operations is that in the Miles' operation the abdominal part of the operation is completed before the perineal part is undertaken, while with the modified technic the abdominal part of the operation is commenced but not completed until after the rectum has been removed through the perineal incision.

The object of using such technic is to facilitate dissection and to avoid soiling of the operative field in difficult cases. Patients selected have been those with very large bowels associated with much fat, extensive tumors and small pelvises. Frequently, a combination of two or more of these factors were present. We have also employed it in a few cases of rectosigmoidal cancer when the disease had infiltrated the muscle coats and appearance suggested that the bowel might be ruptured by the usual traction and manipulation.

Operation is commenced in the usual manner for a Miles' dissection, incision, exploration and ligation of the inferior mesentery vessels. The decision as to technic is not determined until the pelvic findings are known. When the modified technic is to be employed, the lateral leaves of the mesocolon and mesorectum are divided and the incision carried across the midline anterior to the rectum. The rectum is separated from the sacrum. Further abdominal dissection will depend upon the individual case. In some instances abdominal dissection has been quite complete and in others rudimentary. After the abdominal dissection has been completed to the degree thought advisable, the sigmoid is divided. The distal segment is allowed to rest in the pelvis, and the proximal end of the bowel is brought through the original incision. Additional pads are placed in the wound to prevent any small bowel from entering the pelvis while the operation is in progress. These pads are held in position by the second assistant while the operation is continued.

The second part of the operation consists of dissection and removal of the bowel by the perineal route. The position of the patient is changed, the feet are placed in stirrups, the buttocks drawn down to the edge of the table, the perineal operative field draped, the anal canal closed and the perineal part of resection carried out in the usual manner. After the specimen is removed through the perineal incision, a hot pad is placed in the lower part of the pelvis,

and the perineal skin surfaces united by means of one or two sutures to hold the pad in place. Sterile towels are then placed over the perineal wound and the patient returned to his original position on the table. Gloves, gowns and drapes are changed and the operation is continued through the original abdominal incision. The new pelvic floor is constructed. The proximal end of the sigmoid is brought through the original or stab incision to form a colostomy. The abdominal wound is closed in layers and dressings are applied. The final step consists of removing the previously placed pelvic pad, inserting a glove pack into the hollow of the sacrum, closing the perineal wound with a few interrupted skin sutures and applying a perineal dressing. This technic might well be termed an abdominoperineal-abdominoperineal operation.

This modification of the Miles' operation may seem to be a clumsy and prolonged procedure due to changing of drapes, gloves, position of patient, etc. These changes do not require more than ten to fifteen minutes. This technic facilitates dissection and permits easy construction of the pelvic floor. This modification is not suggested for routine use but only in those cases in which the Miles' dissection cannot readily be accomplished, and in cases in which there is an increased possibility of soiling by rupture of the gut. In the thirty-three such cases in which this technic was employed, there were four postoperative deaths.

The third type of abdominoperineal resection, which has a limited field of usefulness but is worthy of consideration, is the two-stage Lahey<sup>2</sup> operation. This two-stage operation at one time enjoyed great popularity. It has its greatest field of usefulness when dealing with advanced operable disease in comparatively poor physical risks. In the last sixty abdominoperineal resections the two-stage technic has been employed in only two cases.

The most outstanding objections to abdominoperineal resections have been the high operative mortality and the perma-

nent abdominal artificial opening. An abdominal colostomy, after a rectal resection in a clinically cured patient, is not a great handicap nor a very objectionable feature, provided the patient is taught how to care for the opening<sup>3</sup> and is fitted with a suitable abdominal support. The objectionable features of an artificial opening in a patient free of disease must not be confused with the objectionable features of a colostomy in a debilitated patient with incurable cancer. In the latter instance, many of the disagreeable features are due to the advanced disease and not to the artificial opening. A well functioning colostomy in a patient free of disease does not interfere with ordinary routine work or way of life. A large percentage of our patients, who are clinical cures, enjoy better health after operation, with a colostomy, than for many years before operation.

The operative mortality for abdominoperineal resections in recent years has shown marked improvement. In many private clinics it is now below 10 per cent, with a more favorable figure for small selected groups. In our clinic, at Memorial Hospital, which consists of both service and private cases, from January 1, 1931, to December 31, 1941, 128 cases were subjected to one-stage abdominoperineal resection with ten deaths, or an operative mortality of approximately 7.8 per cent. The last sixty-nine operations were completed without one postoperative fatality. Prior to 1942, an additional forty-four patients were operated upon by two-stage procedures. In this latter group there were five deaths or an operative mortality of 11.4 per cent. Operative mortality is influenced not only by surgical technic but also by postoperative and preoperative care of patients.

Preoperative preparation requires hospitalization of from five to fourteen days. Operation should be delayed until patients are relieved of intestinal stasis and the general physical condition has been raised to a status satisfactory for major surgery. The colon is cleansed by means of epsom

salt, sufficient to produce three to five stools daily, and by daily irrigations. During the past two years we have employed a high caloric low protein diet from the time of admission until thirty-six hours before operation. The day prior to operation cathartics are discontinued and diet consists of hard candy and fruit juices only. Liberal amounts of vitamins and intramuscular injections of liver are administered daily. Other factors necessary for improving the physical condition will be revealed by careful detailed physical and laboratory investigations. Laboratory investigations should include tests for liver damage, as a large number of patients with malignant disease of the terminal intestinal tract have been found to possess varying degrees of liver dysfunction.

The anesthetic in rectal resections is very important. We prefer spinal, using pantocaine and glucose, with liberal preoperative sedation. Spinal anesthesia may be supplemented with small amounts of pentothal sodium, when patients are restless and apprehensive. This technic has proved exceedingly gratifying during the past two years. While spinal is the anesthetic of choice, when properly administered and controlled, a general anesthetic is preferable to poor spinal.

All our patients receive a transfusion of bank blood during the operation, with additional infusions of glucose and saline as thought advisable. We have not used the sulfonamide group of drugs within the abdominal cavity as a means of preventing infection, nor have we employed them preoperatively. In a few of the recent cases, a small amount of sulfathiazole has been sprinkled in the pelvic wound before inserting the pack, as a means of decreasing the degree of infection and providing a cleaner wound when the pack is removed.

Postoperative care consists of maintaining the good physical condition obtained prior to operation, and relieving any surgical complications that may arise. Frequent blood chemical analyses are necessary to guide a satisfactory postoperative course

for a number of these patients. In addition to the usual blood counts and hemoglobin estimation, one must include tests for liver damage such as prothrombin, serum protein, bilirubin, etc. When a satisfactory blood picture is maintained, the postoperative course is usually smooth and uneventful. Following operation, fluid balance is maintained by intravenous saline and glucose until such time as sufficient fluid can be taken by mouth. Low prothrombin levels may at times be raised by injections of vitamin K. Anemia and serum protein deficiencies are controlled by the administration of whole blood or blood plasma. During the past two years we have encountered a number of patients with liver damage whose condition was made worse by injection of whole blood but who were at once improved when blood plasma was administered. Surgical complications are not frequent but when they do occur require careful surgical judgment for diagnosis and treatment.

#### CONCLUSIONS

1. The Miles' one-stage abdominoperineal resection is the operation of choice for the majority of operable rectal and rectosigmoidal cancers.
2. The above described modification of the Miles' technic is considered an advantage in certain cases.
3. Patients with abdominal colostomies frequently enjoy better health than before operation.
4. The operative mortality in radical resections may be kept within a reasonable figure by careful surgical technic and by detailed consideration of the patient's condition prior to, during, and after operation.

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# Case Reports

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## CHRONIC INTUSSUSCEPTION DUE TO SUBMUCOUS LIPOMA OF ASCENDING COLON\*

### CASE REPORT

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SUBMUCOUS lipoma of the colon is still apparently of sufficiently infrequent occurrence to warrant report when encountered clinically and, since resection of the bowel is a common method of treatment of this condition, such a report has the added advantage of providing the opportunity for discussion of some of the more important points appertaining to this surgical procedure.

The latest report to come to the notice of the writer is that of Gault and Kaplan<sup>1</sup> who also review the recent literature on the subject. These authors found reports of thirteen cases which had appeared since the publication in 1937 of the comprehensive article by Pemberton and MacCormack<sup>2</sup> and added one of their own. Pemberton and MacCormack reported a total of 116 cases of submucous lipoma of the large bowel, ninety-seven of these having been clinical cases which manifested symptoms, while in the remaining nineteen the condition was discovered only at autopsy. The fourteen additional cases in Gault and Kaplan's report all belong to the clinical group.

Those lipomas which qualify for admission to this group possess the intriguing interest of always being able to foil the diagnostic efforts of the clinician, for the symptomatology to which they give rise is not specific in character for lipomas, as such, but is simply that of the complica-

tions which may result from the presence of any tumor of the bowel. Even at operation inspection of that part of the bowel in which the tumor is situated and palpation of the tumor itself through the wall often leave the diagnosis in doubt, the true nature of the tumor not being revealed until either the bowel is opened or the resected specimen examined.

In brief, the symptoms are those of intestinal obstruction with or without melena. The former are consequent upon either the growth of the tumor to a size sufficient to encroach upon the lumen of the bowel to such an extent as to interfere with the onward passage of the fecal contents or due to its presence stimulating the musculature of the bowel sufficiently to attempt its extrusion by forcible contractions, with the production of an intussusception. The obstructive symptoms vary in intensity and are usually of a mild, chronic type but on occasions more severe symptoms, in the form of definite acute attacks, render more urgent the patient's desire for medical advice. Acute symptoms, however, are not nearly so likely to be present as when these tumors are situated in the small bowel. Melena, should it occur, is usually due to erosion of the dome of the lipoma or, more rarely, to pressure ulceration of the adjacent mucous membrane, as in the case

\* From the Division of Surgery, Sansum Clinic, Santa Barbara.

about to be reported, and commonly takes the form of repeated, small hemorrhages.

Pemberton and MacCormack mention that a palpable abdominal mass was present in sixty-four of the ninety-seven clinical cases they reported, indicating this finding to occur on the average in two out of every three cases. In Gault and Kaplan's fourteen cases much the same average was maintained, for a tumor was palpable in eight. While the presence of such a mass may be due to the tumor itself, an intussusception associated with the tumor or the accumulation of fecal matter just proximal to it may be the factor determining whether or not a mass will be palpable. The case about to be reported is of particular interest in connection with this physical sign.

For the nearest approach to the correct diagnosis we usually have to rely upon the barium enema but, as with the symptomatology, a lipoma gives no characteristic findings. However, in the presence of a lipoma giving rise to symptoms, this roentgenological procedure rarely fails to disclose evidence of pathological change in the large bowel, even though the information may be given to us in such general terms as "filling defect," "polypoid tumor," "obstructive lesion" or "intussusception" or, more specifically, and wrongly, as "carcinoma." Nevertheless, the knowledge obtained from the administration of a barium enema is thus of the greatest importance for it will not only tell us definitely of the presence of a pathological lesion of the large bowel but will also often localize it for us and so provide the necessary information upon which operation can be justifiably advised and intelligently planned.

It is generally agreed that the frequently long clinical history associated with a lipoma, the usual good general condition of the patient and the absence of weight loss are features which tend to deny the common roentgenological diagnosis of carcinoma. However, these features point only to the probability of a benign lesion being the cause of symptoms, but such a lesion is

much more likely to be an adenoma rather than a lipoma. In a series of autopsy specimens of polypi of the intestine reviewed by the writer<sup>3</sup> some years ago, only two out of forty-four of those in the colon were lipomas, while no less than thirty-six were of the adenomatous type.

The treatment of a submucous lipoma of the colon consists essentially of surgical removal and, while in some cases this has been done by incising the bowel and removing the tumor, the more usual procedure employed has been a resection of the tumor-bearing segment of the bowel in one or more stages.

#### CASE REPORT

Mr. R. F. was admitted to the Santa Barbara Cottage Hospital on March 26, 1940, his complaint being hemorrhage from the rectum. The day before admission he had passed "about a pint" of blood per rectum in the form of clots, both black and red in color, following a movement of the bowels. This was the only severe hemorrhage he had ever experienced.

For the past three years he had suffered from chronic constipation, having nearly always to resort to the use of an enema in order to obtain a bowel movement. During this time there had been no attacks of diarrhea but on occasions he had passed small amounts of blood. From time to time he would be seized with lower abdominal pain which was never colicky but always of a dull, aching character. He noticed that an evacuation of the bowels would always relieve the pain but on several occasions, when he had not been able to obtain relief in such a manner, a lump would develop in the left side of the abdomen, to disappear when the bowels eventually moved. He had often been troubled with tenesmus and his stools appeared to him to be no greater than a pencil in diameter.

His appetite was good and he had no indigestion. During the past year he had noted a loss in weight of a few pounds.

The patient was a well nourished man who appeared in good health. His systolic blood pressure was 118 mm. of mercury and his diastolic, 80. Heart and lungs were normal. The abdomen was soft, there were no tender areas and careful palpation failed to reveal the presence of a mass. (Abdominal examination was repeated daily before operation but always

with this same result.) Rectal examination revealed nothing of importance. Urinalysis was negative and the blood showed a hemoglobin of



FIG. 1. Film of preoperative barium enema showing marked dilatation of transverse colon and incomplete filling of cecal area.

13.5 Gm. (90 per cent), 4,510,000 red cells and 7,050 white cells with a normal differential count. Examination of the feces was positive for blood by the Benzidine test and no parasites or ova were found.

A barium enema was administered and the following report was given by Dr. Milton Geyman:

The distal colon filled without evidence of filling defect as observed during screen study. The transverse colon, and more particularly the hepatic flexure, was markedly widened. At the cecum the barium column met a mass which prevented filling of this region. The enema pressure was continued for several minutes without further filling. Gentle palpation was also unsuccessful. No mass could be palpated over this area of incomplete filling.

A film study made before evacuation shows the above picture. (Fig. 1.) A film after this had taken place shows almost complete emptying of the colon. An abnormal mucosal pattern is shown in the splenic flexure area. The proximal colon is completely empty except for a tubular segment of rather peculiar arrangement. There is no evidence of obstruction proximal to the cecum in the way of gaseous meteorism.

The incomplete filling of the cecal area suggests an intussusception even though no mass is palpable. The arrangement of the barium coating, as shown in the after-evacuation film, in the splenic flexure suggests a diffuse marginal infiltration, probably on a carcinomatous basis.

Operation was performed on April 2, 1940, under a general anaesthetic of nitrous oxide, oxygen and ether. The peritoneal cavity was opened through a right paramedian incision, the rectus muscle being retracted laterally. A portion of the transverse colon presented and this was seen to be of normal color, but markedly dilated and on palpation it was abnormally bulky. On passing the hand distally along the colon a mass about the size of a large tangerine and of firm consistency was discovered a few inches proximal to the splenic flexure. Examination of the proximal portion of the colon revealed that the cecum, most of the ascending colon and several inches of the terminal ileum were invaginated into the transverse portion of the large bowel. The reduction of this intussusception was accomplished without difficulty and, when completed, the tumor previously felt near the splenic flexure assumed its rightful place in the ascending colon about three inches above the ileocecal valve. Its surface was slightly nodular and it was thought to be a large adenomatous polyp although the possibility of polypoid carcinoma was considered. However, there were no enlarged glands along the course of the right colic artery and the liver was free from metastatic deposits. The ileum was not dilated nor did its terminal portion, which had been part of the intussusceptum, show any abnormal change.

It was decided to do a formal resection of the terminal few inches of the ileum and the right half of the colon. This was carried out, the cut ends of the ileum and the transverse colon being closed by inversion and the continuity of the bowel re-established by an isoperistaltic side-to-side anastomosis. The abdominal wound was then closed in layers without drainage.

*Pathological Report.* (Dr. Clark Brown.) Gross: The specimen consists of a segment of terminal ileum, cecum and proximal colon. (Fig. 2.) The large intestine measures 22.0 cm., from the ileocecal valve to the point of excision. A strip of mesenteric fat is attached to the specimen. Nine cm. above the ileocecal valve a polypoid structure measuring 7.0 by 4.0 by 4.0 cm. extends into the bowel lumen. This is covered with intact mucosa on all surfaces.

Section shows it to be composed of firm, glistening fat. The tumor is attached to the bowel wall by a short pedicle 1.0 cm. long and

eighteen months after his operation. He reported that he was in excellent health, that he had never lost a day's work except through an



FIG. 2. Photograph of resected specimen with tumor bisected to show its lipomatous character.

2.0 by 1.0 cm. on cross section. Beside the pedicle is an area of irregular superficial ulceration measuring 2.0 by 2.0 cm. It appears to have resulted from frictional contact with the polyp. The remainder of the mucosal surface of the large bowel appears normal. An appendix 9.0 cm. long and 0.7 cm. in diameter is attached to the cecum. The surface is smooth, the wall of usual thickness and the lumen contains fecal material.

**Microscopic.** Section of the polyp shows it to be composed of a core consisting mostly of mature fat cells. Strands of fibrous tissue, a nodule of smooth muscle and scattered foci of lymphocytes are also seen in the polyp. It is covered with mucosa. In the section of adjacent colon the mucosa is seen to be ulcerated. The submucosa contains lymphocytes, fibroblasts and macrophages. Mesenteric lymph-nodes included with the specimen are hyperplastic and edematous.

**Diagnosis.** Lipomatous polyp of the colon with contact ulceration.

The postoperative course was uneventful. The wound healed per primam and the patient left the hospital seventeen days after his operation. He returned for examination a month after leaving the hospital and by that time was already doing light work at his job as a carpenter. The abdominal wound was firm and, in marked contrast to the constipated state of his bowels for the three years previous to his operation, he was having regular daily bowel movements.

He was seen again in September, 1941,

attack of "flu" and that he had continued to have a bowel movement daily. At this time he was given a barium enema, a photograph of the film of which is shown in Figure 3. The following is the report on this enema: The colon was studied by a barium enema administered under fluoroscopic control. The mixture passed without difficulty all the way through the colon. The cecum, ascending colon and hepatic flexure have been resected and now there is what appears to be a side-to-side anastomosis between the terminal ileum and transverse colon at a point approximately two inches from the stump of the resected colon. There is no evidence of infiltration, obstruction or other abnormality at the site of the anastomosis and no abnormality is demonstrated in the colon or terminal ileum.

#### COMMENTARY

This was yet another case of lipoma of the colon in which the roentgen diagnosis was that of a lesion of probable carcinomatous nature while the clinical features of a long history, a general condition of the patient lacking any suggestion of cachexia and the mild degree of weight loss pointed to the presence of a benign lesion. However, there were two features present in this case which are not commonly mentioned in other case reports and are therefore of interest. The first was the occasional appearance of a mass felt by the patient in

the left side of the abdomen. Its disappearance always and only after a bowel movement had taken place seems to indicate



FIG. 3. Film of barium enema eighteen months after operation. The remaining colon is of normal caliber and the stoma between ileum and colon is functioning well.

that it was due to an accumulation of feces behind the tumor, for while the patient was under observation for several days prior to the operation, during which time a daily enema was given with satisfactory results, repeated careful abdominal examination failed to elicit the presence of a mass. However much the increased bulk of the transverse colon due to the intussusception might have added to the size of the tumor, it was insufficient to do so to the extent of rendering it palpable; for the bowel was found intussuscepted at operation and no mass was palpable immediately before the abdomen was opened. The second unusual feature was the type of hemorrhage and its origin, the former because in these cases severe hemorrhage is the exception to the general rule of repeated small ones, although these had taken place; hitherto, the only source of hemorrhage reported in a case of lipoma appears to have been an erosion of the dome of the tumor, but in this case such a superficial ulceration

occurred, not on the tumor itself, but in the mucous membrane of the bowel close to the short pedicle and it was apparently from this ulcer that the hemorrhage had originated. Ulceration in this situation is of further interest in that it supports the thesis that the intussusception was caused, not by the passive drag of the tumor on the bowel wall, but by the active efforts of the bowel musculature to extrude what was virtually a foreign body. In endeavoring to do so the bowel wall contracts down upon the tumor and this abnormally contracted part is forced by increased peristaltic movements through the abnormally relaxed portion of the bowel below. The repeated contraction of the bowel wall down upon the tumor is a reasonable explanation of the occurrence of ulceration of the bowel mucosa through pressure of the tumor upon it.

A tumor having been found inside the ascending colon, the question then arose as to the best procedure which should be adopted to accomplish its removal, the answer to which question depended largely upon the probable pathological condition present. It was sufficiently hard in consistency to have been a frank polypoid carcinoma although, since the tumor was of such a large size, the absence of enlarged glands in particular weighed rather heavily against this diagnosis. As a benign tumor, its most likely pathological status was that of an adenoma for, as mentioned previously, this is by far the most common type of benign tumor of the large bowel. It was demonstrated clearly by the writer in his review, to which reference has already been made, not only that adenomas are capable of undergoing malignant change but that this may be expected in any adenoma which has grown to about the size of a walnut. Since this tumor greatly exceeded such proportions, it could be taken for granted that malignant change was present if the probable diagnosis of adenoma were correct. These considerations, in conjunction with the good general condition of the patient, were those responsible for the

decision to perform a resection of the proximal half of the colon as the method of choice of removal of the tumor, since a local extirpation through an opening in the bowel can never be accepted as an adequate form of treatment for a large adenoma owing to the danger of leaving behind imperceptible malignancy in the bowel wall. The true nature of the tumor was thus not determined until the resected specimen was examined.

Of particular interest to the writer are the cases in which the resection of this portion of the colon has been undertaken in multiple stages and especially those which have included, not the closed ileocolostomy, but the open type, thus necessitating a period of several weeks during which the patient must submit to the nuisance (to say the least) of an abdominal anus and prolonging into months the time that he must be under surgical care. As the outcome of his personal experience, the writer has come to the conclusion that, in cases in which resection of the right half of the colon is indicated as the treatment of choice, whether this be for the presence of benign tumor, hyperplastic tuberculosis or malignant disease, to mention the three conditions for which this operation is most commonly performed, the need for any procedure other than the single-stage operation rarely arises. Only in the minority of cases, such as those in which obstruction has resulted in changes in the bowel or in which the general condition of the patient leaves much to be desired, need it be considered advisable or necessary to complete the resection in more than one stage. When for such reasons it is decided to do the operation in multiple stages, the writer believes that a primary ileocolostomy, to be followed by the secondary resection, is the procedure of choice. However, the Mikulicz type of operation still appears to have considerable popularity<sup>2</sup> although it is difficult to see what advantages it possesses over the two-stage method just mentioned. In the first place, the first stage of the Mikulicz operation

entails a mobilization of the bowel just as extensive as when primary resection is performed. Furthermore, it would seem that if the patient can withstand the dissection necessary for this mobilization, he can certainly also withstand the additional resection which, on completion of the mobilization, takes but little time and should in no way jeopardize his chances of recovery from the operation. Once the resection has been done, there remain the basic alternatives of either exteriorizing both cut ends of the bowel in the form of a double-barrelled colostomy or at once restoring the continuity of the bowel by an anastomosis. The disadvantages inherent in the former have been mentioned briefly and, from the patient's standpoint, they should be sufficient to deter the surgeon from performing this procedure whenever possible. The chief argument used against the latter alternative is the risk of leakage of intestinal contents at the site of anastomosis, leading to a peritonitis which, should it happen to occur, is generally fatal.

It is, therefore, important to examine the etiological aspect of anastomotic leakage. In cases in which this catastrophe has occurred it is interesting to note that the anastomosis has almost invariably included an "end," that is, it was of the end-to-end or end-to-side type. Moreover, in reports of such cases it usually appears to be inferred that the blame for leakage has primarily to do with the actual line of suture rather than with the bowel itself. The fact is, however, that the success or failure of such an anastomosis is largely determined before the first suture has even been begun. The reason for this is that the essential factor responsible for the success of any "end" anastomosis is the conservation of the blood supply of the bowel right up to its cut edge. Failure to carry out this conservation, whether unwittingly or through lack of appreciation of its fundamental importance, is likely to end in disaster no matter how carefully, or by what technic, the anastomosis is performed, for one or

more areas of necrosis will occur immediately adjacent to the cut edge of the bowel and, should the extent of any one of these areas reach beyond the completed line of suture, it will provide a path of escape for intestinal contents into the peritoneal cavity. Clinical support of this thesis is to be found in the postoperative histories of cases in which leakage occurred, for the symptoms of peritonitis do not usually appear within the first twenty-four hours, as they would if the suturing had been faulty (surgeons experienced enough to be performing bowel resections are not likely to be guilty of failure to make a water-tight anastomosis) but have their onset after a latent period averaging from four to six days, this period representing the time it takes for necrosis to occur.

If this conservation of the blood supply is borne in mind, then in most cases it can be achieved with ordinary care, but it is possible for the most painstaking surgeon to make an error in judgment regarding the site of division of the mesenteric or mesocolic vessels necessary to ensure it. A great help in preventing failure to conserve the blood supply lies in relaxation of the clamps, following which the amount of hemorrhage from the cut edge of the bowel can be observed; should bleeding be absent or scanty, enough of the end of the bowel can be removed until the desired brisk hemorrhage is seen to take place. (A distinct disadvantage of the "aseptic" technic in an "end" type of anastomosis is that it prohibits this relaxation and so denies to the surgeon the certainty that he has conserved the vascular supply to the cut edge of the bowel, on which condition the success of the anastomosis primarily depends.) An even safer procedure to adopt, however, when enough bowel is available, is one which will make due allowance for the possibility of failure to conserve the blood supply having occurred in spite of whatever precautions might have been taken to avoid this outcome. This procedure consists simply of closing the cut end of the bowel by inversion, the

rationale of doing so being that any area which might have become necrotic and so allow leakage will be safely tucked inside the inverting sutures.

When a side-to-side anastomosis is performed, an adequate blood supply to the edges of the bowel incision is assured and here any leakage can thus be attributed directly to a faulty anastomosis and, therefore, should not occur. The small amount of soiling of the peritoneum which is all that is permitted by ordinary careful technic when doing a bowel anastomosis is not sufficient to cause a general peritonitis.

These considerations have led the writer to hold the opinion that, in single-stage resection of the right half of the colon, the danger of leakage from the anastomosis can be averted by inversion of the cut ends of the bowel and the re-establishment of its continuity by side-to-side anastomosis. Up to the present this procedure, which represents the practical application of these considerations, has never failed to achieve its object whenever it has been employed by him, for no instance of leakage has occurred. When this particular resection is done, there is always enough bowel available to permit of this type of anastomosis being performed without undue tension.

The advantages accruing from the single-stage resection of the proximal part of the colon, with inversion of the cut ends of the bowel and side-to-side anastomosis are well exemplified by the present case. The patient had the uneventful recovery the writer has come to expect in cases following this operation and was in the hospital no longer than he would have been for any other major, and perhaps less severe, abdominal procedure. This is in marked contrast to the burden, both economic and surgical, which he would have had to bear had the Mikulicz type of operation been performed.

#### SUMMARY

1. A case is reported of chronic intussusception due to a submucous lipoma of the ascending colon.

2. The roentgenological diagnosis was probable carcinoma of the splenic flexure.

3. Two unusual features were present: (a) The symptom which caused the patient to seek medical aid was a severe hemorrhage from the rectum. (b) The apparent source of the hemorrhage was an ulceration of the mucous membrane of the bowel situated close to the short pedicle of the tumor.

4. A single-stage resection of the terminal few inches of ileum and proximal half of the colon was performed, the ends of the ileum and colon being inverted and the continuity of the bowel re-established by a side-to-side anastomosis. It is considered that in cases in which resection of this portion of the bowel is indicated as the treatment of choice, the need for any procedure other than this single-stage operation rarely arises.

5. The etiology of anastomotic leakage is discussed and it is emphasized that the essential factor upon which depends the success of any "end" anastomosis is the conservation of the blood supply of the bowel right up to its cut edge. The success which attends the type of anastomosis referred to above lies in the fact that it is both an easy and safe method of guarding against a failure to conserve this blood supply, when such failure might readily result in leakage if an "end" type of anastomosis were performed.

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# COLLOID ADENOCARCINOMA OF THE URACHUS\*

## REPORT OF TWO CASES

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IN the clinical evaluation of tumors of the bladder a distinction should be made between the more commonly seen papillary and solid tumors and the rare adenocarcinomas found in the vault of the bladder. These adenocarcinomas arise from the epithelium of the urachal canal and are in reality not tumors of the bladder at all, but merely masquerade as such after they have invaded the bladder mucous membrane.

The work of Begg (1930)<sup>1</sup> added to the knowledge concerning the anatomy, histology and development of the urachus. According to Begg, the urachus developmentally is the upper portion of the anlage of the bladder and is derived from the ventral cloaca. In the adult it is a cone-shaped structure approximately 5 cm. in length extending from the bladder to the umbilicus. The urachus is lined by an irregular form of transitional epithelium.

Begg (1931)<sup>2</sup> collected forty-four cases of tumor of the urachus from the literature. These were classified as follows: Fibroadenoma—3; adenocarcinoma—4; colloid adenocarcinoma—19; mixed tumor—8; fibroma and fibromyoma—4; sarcoma—6. He states that the colloid adenocarcinoma represents primarily a metaplasia of the transitional epithelium followed by a colloid or mucoid degeneration. Sections appear very much like rectal carcinoma.

Kalo (1931),<sup>3</sup> Payne and Jones (1931),<sup>4</sup> Ferrier, Craig, and Foord (1936),<sup>5</sup> Begg (1936),<sup>6</sup> De Waard (1939),<sup>7</sup> Mattel (1940),<sup>8</sup> and others have added cases of adenocarcinoma of the urachus to Begg's original list.

We wish to present the following two

cases of colloid adenocarcinoma of the urachus:

### CASE REPORTS

CASE 1. The patient, a white, married male, physician, aged fifty, was admitted to the Urologic Service at the Hospital of the University of Pennsylvania on August 26, 1940, with the complaint of gross hematuria of six hours' duration.

The patient was well until the day of admission when while voiding he had the sensation that all of the liquid coming from his bladder was not urinc. On observing the stream he found bright red blood. There was no pain at the time. The hematuria persisted each time he voided. When he was admitted about eight hours later he was passing clots which caused him discomfort. There was no history of previous hematuria, frequency, nocturia, urgency, pyuria, or other urinary symptoms.

A weight loss of seven pounds had occurred in the past year. He was operated upon for a ruptured appendix in 1936. His family history revealed no points of clinical significance.

Physical examination showed a well developed and nourished white male, aged fifty, not acutely ill. The chest was clear. The heart was not enlarged, the blood pressure was 130/80. There were no murmurs. In the right lower quadrant of the abdomen there was an old operative scar. The external genitalia and rectum revealed no significant findings.

Laboratory examinations showed the following findings: red cell count 4,780,000, white cell count 7700, blood urea nitrogen 6 mg. per cent, blood sugar 82 mg. per cent. The urine was alkaline and free of sugar, but albumin, red cells, and white cells were present.

Under larocaine anesthesia a No. 24 cystoscope was passed with ease to the bladder. The entire bladder cavity, ureteral orifices and

\* From the Urologic Service of the Hospital of the University of Pennsylvania.

vesical neck appeared normal except for a small opening in the fundus which appeared to be about 2 cm. in diameter. Through this

The upper half of the bladder, containing the growth, was now removed. A collar of approximately 1.5 cm. of healthy bladder was taken



FIG. 1. Gross specimen of resected tumor from Case 1. The surface presenting itself to the bladder is shown. A, the ulcerated surface of the neoplasm; B, the bladder wall consisting of mucosa, muscle and serosa.



FIG. 2. Gross specimen of resected tumor from Case 1. A longitudinal section through the mass is shown. Observe the mucoid appearance of the tissue.

hole was projecting a cluster of tiny fronds which appeared very friable.

The bladder was examined by means of opaque solution and air. The only unusual finding was along the upper border of the bladder where there was a serrated appearance. This same finding was also present on the pneumocystogram.

Through a midline incision from the pubis to the umbilicus the muscles were divided and the peritoneum exposed. A firm conical shaped mass was palpated and found to be projecting above the uppermost portion of the bladder. The peritoneal cavity was opened and the omentum was found to be adherent to the growth at one point. The omentum was doubly clamped above the attachment to the tumor mass, divided between the clamps and the proximal portion ligated. The peritoneum was incised on either side of its bladder reflection and this incision was carried well below the tumor mass. The peritoneum was then further dissected from the lower posterior portion of the bladder wall. This procedure completely freed the upper half of the bladder with the tumor mass. The peritoneum was then closed beneath the bladder with a suture of plain No. 1 catgut.

The bladder was now opened and the previously instilled mercuraphen solution aspirated.

with the tumor. The bladder was then closed with interrupted sutures around a large Pezzer catheter. The skin, subcutaneous tissue and muscle were closed with figure-of-eight sutures of silkwormgut. A skin clip was placed at either end of the incision.

The suprapubic tube was removed on the tenth postoperative day. The fistula closed on the fifteenth postoperative day. The patient was discharged on the twenty-first postoperative day.

The specimen consisted of a tumor removed from the region of the urachus. It measured 6 by 4 by 4 cm. and appeared to be encapsulated. On section it was pale, mucoid and showed deposits of calcium. Microscopic diagnosis: Adenocarcinoma of the urachus with colloid degeneration.

The patient is alive and well at this time. There are no evidences of recurrence or metastases.

CASE 11. The patient, a white male, aged forty-nine, was admitted to the Urology Service at the Hospital of the University of Pennsylvania on February 27, 1942, with the complaints of frequency of urination and hematuria.

He was in good health until three years ago. At that time he observed that he had to empty his bladder more frequently than normal both during the day and at night. There was also burning on urination. These symptoms persisted and three months ago he first observed

blood in the urine. He received irrigations of the bladder and symptomatic treatment from his local physician. However, the bleeding

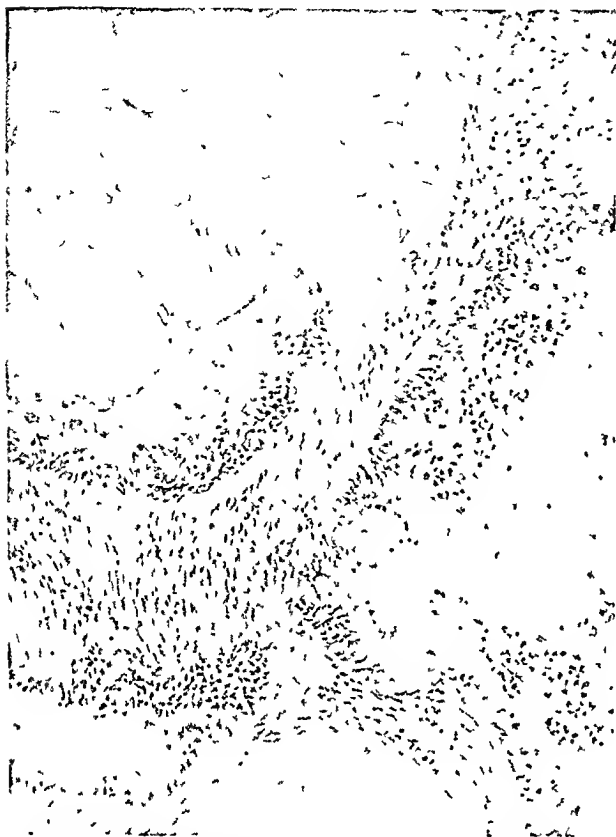


FIG. 3. Photomicrograph of a section of the resected tumor from Case 1. Observe the typical appearance of a colloid adenocarcinoma of the urachus.

became worse so he finally decided to come to the hospital. Thirty-five pounds of weight had been lost in the past year.

Physical examination showed a pale, white male, aged forty-nine, who appeared to be chronically ill. The chest was clear and the heart was not enlarged. The blood pressure was 130/60. There was a harsh systolic murmur at the apex. The abdomen was free of any palpable masses. The external genitalia showed no abnormality. Rectal examination showed a small, smooth, firm movable and symmetrical prostate.

Laboratory examinations showed the following findings: hemoglobin 34 per cent, white cell count 10,000, blood urea nitrogen 13 mg. per cent, and phthalein excretion of 75 per cent in two hours. The urine was alkaline and contained albumin and many red blood cells and white blood cells. Urine culture showed

*Streptococcus viridans* and *Staphylococcus albus*, but no tubercle bacilli.

The chest was clear. Intravenous urogram showed excellent dye excretion on both sides. "There was some dilatation of both ureters in their juxta-vesicular portion. The bladder was quite small and trabeculated. These findings suggest inflammatory changes in the adnexa and probably in the bladder itself." Cystoscopy: The entire bladder dome to a point just above the trigone was extensively involved as a fungating necrotic mass.

The patient was given three blood transfusions of 500 cc. each. The hemoglobin reached 63 per cent. Bleeding from the bladder continued and in spite of transfusion he appeared to be getting weaker.

A midline incision was made from the pubis to a point two-thirds the distance between the pubis and the umbilicus. The muscles were retracted. An attempt was made to strip the peritoneum from the anterior and superior surface of the bladder, but it was densely adherent and involved with neoplastic tissue. The tumor mass extended to the height of the umbilicus and laterally it was firmly attached to the structures of the bony pelvis. A stab wound was made into the bladder on its anterior surface in the midline and the previously instilled antiseptic fluid aspirated. The incision was enlarged superiorly allowing visualization of the bladder contents. The entire bladder with the exception of the trigone, vesical neck, and ureteral orifices was involved with hard neoplastic tissue. A suprapubic tube was placed in the bladder. A portion of the neoplasm was taken for examination. The bladder was closed with interrupted sutures of plain No. 1 catgut. The muscles, fascia and skin were closed with vertical figure-of-eight sutures of silkworm gut.

The patient's convalescence was uneventful. He was discharged on April 1, 1942, with the suprapubic tube in place.

Pathologist's Report: The biopsy of the bladder lesion showed on microscopic examination masses of colloid material with a few scattered pyknotic cells in acinus-like arrangement. Diagnosis: Colloid adenocarcinoma of the urachus.

#### DISCUSSION

The age incidence of urachal carcinoma is the same as found in all epithelial tumors

the great majority being in the fifth decade and above. About 80 per cent of the reported cases are in males. Once the urachal carcinoma has invaded the bladder mucosa and penetrated the bladder, the clinical history and symptoms resemble those in ordinary tumors of the bladder. Appearance in the urine, however, of jelly-like masses is pathognomonic of a penetrating urachal adenocarcinoma. Before the urachal carcinoma invades the bladder mucous membrane, there are no urinary symptoms. Frequently, a mass can be felt suprapubically. In some cases cystoscopically an indentation of the mucous membrane can be seen at the apex of the bladder as a prelude to actual invasion. When the tumor penetrates the bladder, the cystoscopic picture is by no means uniform. The appearance may simulate papillary carcinoma or necrotic ulceration. There may be only a small opening at the apex of the bladder from which a gelatinous substance oozes. Furthermore, the point of bladder invasion may be eccentric in location due to the tumor extending laterally in the bladder wall before penetrating the mucosa. When the bladder penetration is extensive, typical long gelatinous fronds can be seen cystoscopically and, as previously mentioned, these frequently are extruded in the urine.

There is one uniform negative characteristic, urachal tumors are never pedunculated. Distant metastases are rare and occur late. Direct extension into the abdomen frequently occurs. The usual finding has been complete encapsulation of the supravescical portion of the tumor. In our second case this was not so. In the bladder wall the tumor invades the muscular coat without any semblance of encapsulation. This, of course, means that a generous portion of the bladder wall should be resected with the tumor.

The differential diagnosis is most important. Urachal carcinomas must be distinguished from urachal cysts, urachal abscess and tumors of the female adnexa. It is important that urachal colloid carcinomas be differentiated from the usual epithelial tumors of the bladder. The urachal tumors are primarily supravescical and are, therefore, not amenable to any endovesical methods of treatment. Complete surgical removal is the only means of effecting a cure.

Case I which was seen six hours after the onset of hematuria was amenable to surgical excision and after almost two years appears to evidence a complete clinical cure. In Case II, however, the hematuria had been of three months' duration and the cystitic symptoms of three years' duration. Extension of the tumor precluded complete surgical removal so only a palliative procedure could be done.

#### SUMMARY

Two cases of colloid adenocarcinoma of the urachus are described. The diagnosis and treatment of this condition are discussed.

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# MASSIVE MIXED TUMOR OF THE SUBMAXILLARY GLAND\*

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**T**UMORS of the submaxillary gland are far less common than are growths developing in the parotid. The present case of submaxillary gland tumor is reported because of the interest it created regarding both diagnosis and management. The literature contains numerous reports of parotid tumors and it is not surprising that much less attention has been devoted to the more uncommon submaxillary growths.

According to Ewing<sup>1</sup> three groups of epithelial tumors occur in the salivary glands: These are the true adenomas which are rare, the relatively more frequently found carcinomas and the mixed tumors.

The origin of the mixed tumors has long been a subject of active controversy. The histological structure of these neoplasms is complex, the epithelial elements usually taking the form of cell strands, alveoli or diffuse masses. The mesoblastic portion of such neoplasms consists chiefly of fine connective and mucous tissue and in many instances cartilage is present. It is of interest that the tumors are not always in obvious connection with the gland. Such tumors may be found in the floor of the mouth, in the retropharyngeal tissues or in any part of the lateral wall of the neck.

One of the most complete studies of mixed tumors of the salivary glands is that of McFarland.<sup>2,3</sup> After carefully studying a collection of 300 cases in which attention was given to history, operative findings, microscopic study and a follow-up over a period of years, a number of rather striking conclusions were reached. McFarland believed that the microscope offered little or no aid in determining the likelihood of recurrence of mixed salivary gland tumors.

Recurrences were found to occur any

time from immediately after the operation up to forty-seven years later. While little definite help regarding recurrences of the mixed tumors was given by the microscope, he definitely believed that tumors removed while they were still quite small were far more likely to recur. This was credited to the greater likelihood of overlooking a small bit of tumor tissue. It was also reported that radium and x-ray offered no advantage over surgery in the treatment of such cases.

## CASE REPORT

J. P., a colored male, age fifty-eight, was referred to me July 30, 1941, by Dr. J. T. Davis of Corinth, Mississippi. The patient complained of a large tumor on the left side of the neck which was first noticed twenty-five years before. At the onset the tumor presented as a small mass below the body of the mandible. The growth gradually became larger and prior to admission caused the patient considerable inconvenience, chiefly because of its size. Four months before admission the floor of the mouth was found to be elevated on the left side. Examination revealed a mass that extended from the body of the mandible to a point about 1½ cm. above the clavicle. Posteriorly the mass lay beneath the sternocleidomastoid muscle and anteriorly it extended almost to the mid-line. The floor of the mouth was elevated on the left side. The tumor could be moved slightly from side to side but could not be moved in the vertical direction. The greater portion of the mass felt solid, however, an area 4 by 4 cm. near the apex of the tumor was cystic on palpation. The other general findings were normal.

At operation, novocaine anesthesia was used, the cervical nerves being blocked near the transverse processes of the cervical vertebrae on the left side. Some additional infiltration was carried out along the posterior border of

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the sternocleidomastoid muscle. An incision through skin and fascia was made along the anterior border of this muscle. The tumor was

the lesion was benign. The referring physician strongly considered the diagnosis of carotid body tumor because of the location

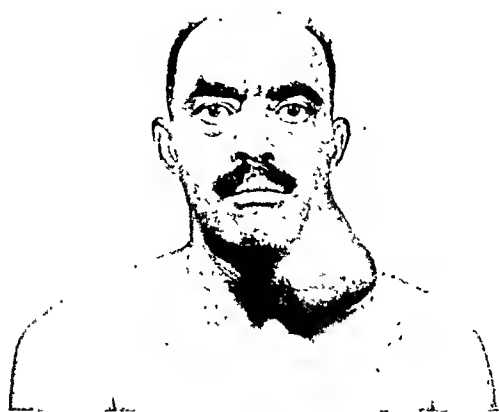


FIG. 1. Mixed tumor of left submaxillary gland of twenty-five years' duration.

well encapsulated and contained no true pedicle. It was in intimate contact with the carotid sheath from which it was dissected free. The wound was closed with interrupted sutures and healed within a week. Follow-up examination six months later showed the patient to be apparently entirely well.

The gross pathological specimen consisted of a mass of tissue 13 by 9 cm. At one pole of the tumor was a cystic area 3 cm. in diameter. The tumor had a thick fibrous capsule. On section it was seen to consist of firm, whitish tissue which was divided into lobules by fine strands of connective tissue. The cystic portion of the tumor was filled with brownish fluid. This probably represented an area of degeneration.

Microscopically, the tumor, which was well encapsulated, was made up largely of epithelial cells. These cells were arranged in cords and sheets and in some areas tended to form alveoli. The cells had nuclei which were oval or polyhedral in shape. The cytoplasm was granular and the cytoplasmic edges were rather indistinct. Scattered throughout the tumor were areas of fine fibrillar connective tissue shown exceptionally well by the Mallory stain. This fine connective tissue enmeshed mucus which was best demonstrated by the mucocarmine stain. No areas of true cartilage were seen.

#### COMMENT

Because of the long history and lack of fixation of the tumor it was believed that



FIG. 2. Gross specimen of benign mixed tumor of submaxillary gland.

of the mass and because lateral movement was possible while vertical movement was not. The author was of the opinion that a tumor arising from branchial cleft remnants should be strongly considered as well as that of a tumor of the submaxillary gland. A definite diagnosis was reached only after a careful microscopic study of the tumor.

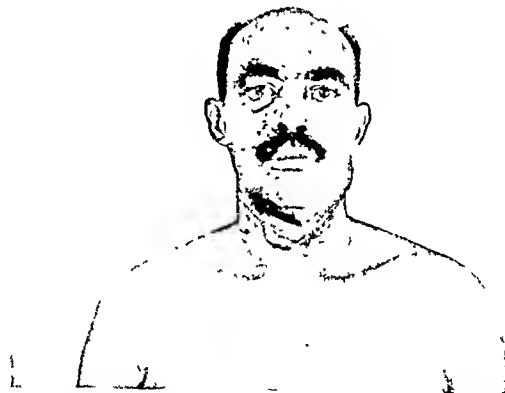


FIG. 3. Patient, ten days after removal of tumor under cervical block anesthesia.

Regional anesthesia as given by cervical block was considered the anesthetic of choice since it caused the patient relatively little general disturbance and also made it possible for the patient to co-operate throughout the operation. Such co-operation is of aid in preserving the facial nerve which is not infrequently distorted by such growths.

## SUMMARY AND CONCLUSIONS

1. Three types of epithelial growths occur in the salivary glands, these being in the order of their occurrence the mixed tumors, carcinomas and the relatively rare true adenomas.

2. Mixed tumors of the submaxillary gland clinically and histologically resemble those of the parotid although the latter tumors are encountered much more frequently.

3. Salivary gland tumors do not always arise in the conventional location as they

may occur in the floor of the mouth, in the retropharyngeal region or in the lateral walls of the neck.

4. A case of a massive mixed tumor of the submaxillary gland successfully removed under local anesthesia is reported.

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NITROUS oxide and oxygen may be administered simultaneously to supplement spinal anesthesia when blood pressure is satisfactory and oxygen may be used alone when blood pressure is low.

# RECONSTRUCTION OF THUMB\*

## A NEW TECHNIC

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THE hand is the most important part of the upper extremity and the thumb is the most important part of the

### CASE REPORT

The deformity was produced in an accident while at work in a hat company when she

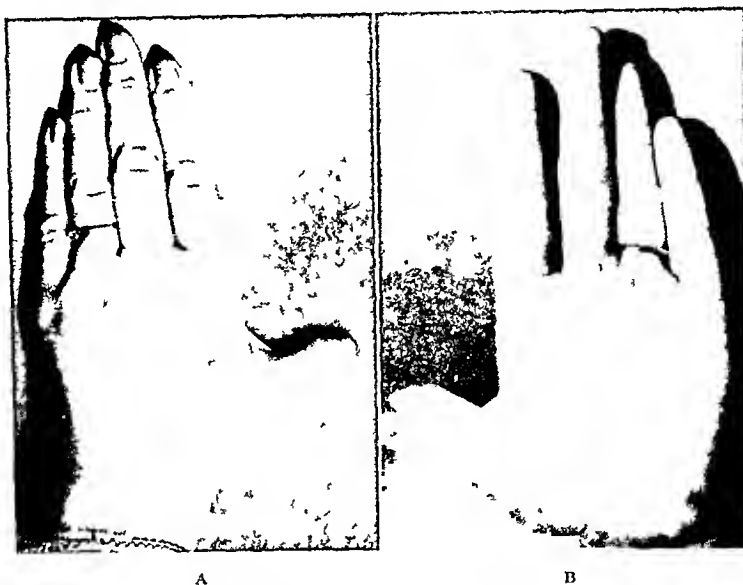


FIG. 1. A, loss of upper part of thumb (dorsal view). B, loss of upper part of thumb (palmar view).

hand. Loss of a thumb means not only disfigurement but what is more important, the loss of the usual and proper function of the hand. Thus the thumb is vital from a functional and psychological viewpoint and becomes even more so when our hands are important to us economically in industry or in professional life.

For example, the case herein illustrated is a woman of fifty-one who, as a result of an industrial accident, lost part of her thumb. This meant loss of livelihood since her skill as a milliner went with the loss of the digit. To rehabilitate her thumb was therefore important to her and her family.

stuck her left thumb with a milliner's needle. The digit became so badly infected that she was confined to a hospital for two months. When she was discharged she had a marked deformity of the left thumb. The nail, the distal phalanx and part of the proximal phalanx was missing. The tip of the remaining part of the thumb was covered with a firm scar that was very sensitive to touch. This meant that the patient could not use her thumb; the function of her hand was greatly impaired. (Fig. 1.)

To increase the size of the thumb to normal proportions and thereby restore the natural function of the hand a plastic reconstructive repair was indicated. Not only was a tubed

\* Presented at the Symposium on Reconstructive Plastic Surgery at the West Side Hospital and Dispensary, January, 1942.

pedicle graft of skin needed to restore the length of the thumb but a peg of bone was necessary to replace the lost phalanx. This



FIG. 2 Shows tubed pedicle of skin from abdomen attached to thumb

meant that a series of procedures were necessary. They were as follows:

Under general anesthesia a tubed pedicle skin graft about the circumference of her normal thumb was prepared from the integument of her abdomen in the region of the left lower quadrant. The skin was rolled into a tube

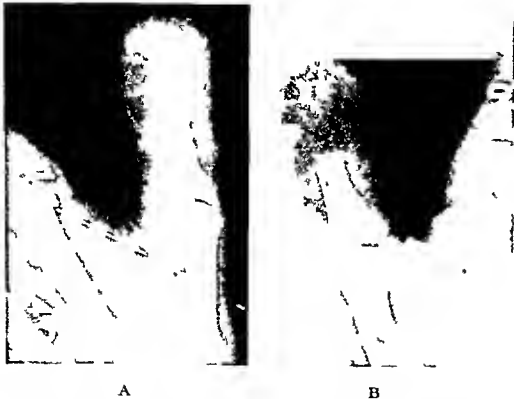


FIG. 3. Distal phalanx absent. Small part of distal portion of proximal phalanx has been amputated, soft tissue of thumb wider than normal.

by means of interrupted sutures of fine silk, but both ends of this tube were left attached to the abdomen. However, the wound under the tube was closed by undermining the opposing edges of the wound and approximating them with interrupted sutures of medium silk. The wound and tube were dressed with gauze saturated with azochloramid. The dressings

were changed every other day and within a week to ten days the stitches were removed.

Three weeks after the tube had been formed



FIG. 4. Bone graft procured from lower third of left tibia.

the second stage of the operation was performed. Under general anesthesia the scarred area over the tip of the thumb was excised and the pointed extremity of the proximal phalanx was chipped off and rounded out. The distal end of the tube was then detached from the abdominal wall; it was subsequently unrolled to ensconce the tip of the thumb, that is the tube was attached to the raw surface of the thumb by means of interrupted sutures of silk. A plaster of paris cast was applied around the abdomen and arm to prevent motion of the graft, but an open window was left in the cast to permit view and treatment of the thumb and graft.

After two and a half weeks the cast was removed. The proximal end of the tube was detached from the abdominal wall and repaired in such a way as to simulate the end of a thumb. (Fig. 2.) The abdominal wound was closed by undermining and approximation of the wound edges.

Healing took place without any untoward result, but since the patient did not feel well she decided to wait a while before submitting to the other stages of the operation. However, during the next two months, her general condition was improved by medical and dietary treatment. At the end of that time radiographic examination of the left thumb showed the following (Fig. 3):

The distal phalanx was absent and a small part of the distal portion of the proximal phalanx had been amputated. The bony mar-



FIG. 5.



FIG. 6.

FIG. 5. Shows distal end of bone graft. Proximal end of this bone graft is wedged into the split proximal phalanx of thumb.

FIG. 6. Tube closed with interrupted sutures of silk.



FIG. 7. Bone graft in perfect position wedged into proximal phalanx.

gins were smooth and there was no evidence of any gross pathological condition. The soft tissues of the thumb were wider than normal

extended to about the upper third of the forearm. The cast remained in place for about eight weeks and when removed, radiographic exami-



FIG. 8. Tip of thumb rounded out to simulate natural appearance.



FIG. 9. Function of thumb restored; ability to adduct thumb to fingers indicated.

and had an artificial character which showed no indication of the presence of disease.

Finally she submitted to the next procedure. This consisted in a bone graft operation. I was assisted at that time by Dr. R. Preston. The soft tissues of the skin flap were opened to expose the proximal phalanx of the thumb. This phalanx was split longitudinally with the Albee motor saw, the saw cut extending from the distal end to about one-fourth of an inch from the proximal end of the phalanx.

From the lower third of the left tibia (Fig. 4) a bone graft about  $2\frac{1}{2}$  inches long was removed with the Albee saw. The proximal end of this bone graft was shaped as a wedge. This wedge was of the proper length and shape to fit into the previously split phalanx of the thumb. (Fig. 5.) The distal end of the bone graft was about  $\frac{5}{8}$  of an inch wide. This portion of the graft extended a distance of about  $1\frac{1}{2}$  inches beyond the end of the split phalanx.

The soft tissues of the flap and stump of the thumb around this graft were closed with interrupted sutures of No. 0 chromic catgut and the skin was closed with interrupted sutures of medium silk. (Fig. 6.)

A plaster of paris cast then immobilized the stump of the thumb and the graft; this cast

nation (Fig. 7) revealed that the bone graft was in perfect position, wedged into the proximal phalanx.

Two weeks later, a plastic operation was done on the integument and subcutaneous tissue of the tip of the thumb to give it more natural shape. (Fig. 8.)

Figure 9 shows proper closure of fingers of hand and ability of the thumb to adduct to the fingers. Of course, the joint between the proximal and distal phalanx is gone but the usual and important function of the thumb has been restored. Figure 10 shows the palmar view. The thumb looks perfectly normal but minus a nail. Figure 11 shows palmar view of thumb with artificial nail. Figure 12 shows dorsal view of artificial nail and thumb. The thumb is adducted to the fingers showing restoration of function.

For the purpose of quick easy undermining of the skin I have perfected a double-edged detachable knife. (Fig. 13.) The value of the double-edged feature is obvious in that the knife is twice as sharp as the ordinary one and, therefore, can be used

twice as long and twice as effectively without change of instrument.

At the rearward portion of this double-

It is gratifying to learn that Dr. A. H. McIndoe, head of the plastic reconstructive division of the R. A. F. is at present using



FIG. 10. Palmar view; nail missing.



FIG. 11. Palmar view; artificial nail attached.



FIG. 12. Dorsal view showing artificial nail attached; ability to adduct thumb to fingers indicated; normal function of thumb restored.



FIG. 13. Author's double-edged detachable knife.

edged blade is a v groove designed to abut the walls in the projection of the handle member. There is an orientation knob on the handle which informs the surgeon which sharp edge he is using. The part of the blade that is not sharp is rib-backed which permits easy detachment of blade from handle.

The idea of a detachable blade is not new, but the double-edged feature is original and exceedingly useful not only in plastic repair but in any form of surgery as well.

this knife on wounded pilots with excellent results.

#### CONCLUSION

I believe that this type of procedure is the most advantageous for the reconstruction of not only the thumb but of other fingers as well. It proves that the knowledge of bone grafting as practiced by the orthopedic surgeon can come in good stead for the reparative surgeon in order to achieve excellent functional and cosmetic results in such cases.



# PLACENTA ACCRETA FOUND AT CESAREAN SECTION FOR PLACENTA PREVIA\*

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**P**LACENTA accreta may be defined as that pathological entity in which the placenta is intimately adherent to the musculature of the uterus, due to a deficient or absent decidua basalis. This condition was known to the older obstetricians who called it adherent placenta. Berry Hart, in 1899, and Huffmeyer,<sup>1</sup> in 1890, were the first to publish observations of this condition which included histological studies.

Placenta accreta is a rare obstetric complication. In 1938, King<sup>3</sup> reported three cases of his own and stated that the total number of cases in the literature was 109 at that time. The frequency of occurrence varies from one in 40,000 cases as stated by Hirst<sup>4</sup> to one in 20,000 cases reported by Kraul;<sup>5</sup> one in 12,000 by Kraften;<sup>6</sup> one in 8,000 by Stoeckel<sup>7</sup> and one in a little under 2,000 reported by Irving.<sup>8</sup> An average incidence from the figures of ten observers is one in 14,600 deliveries.

Placenta accreta has been found as early as the third month of gestation and occurs up to full term pregnancy. Normally, the placenta is made up of villi and intervillous spaces and the decidua basalis is found beneath the villi and is penetrated by them in some places. In other words, the decidua basalis lies between the villi and the myometrium. The decidua basalis is made up of two layers, the compacta which lies near the villi, and the spongiosa which lies against the myometrium. After expulsion of the fetus the venous spaces are filled with blood and with the contractions and relaxations of the musculature separation occurs between the compacta and the

spongiosa, at a plane where the erosive process of the trophoblast in the decidua stops. The slightly grayish, firmly adherent membrane which one normally sees on the maternal surface of the recently delivered placenta is the decidua compacta. When the decidua spongiosa is absent separation is difficult. When the decidua compacta is completely or partially absent, the separation is even more difficult. If the chorionic villi are in direct contact with the muscle layer, separation is impossible without tearing portions of the myometrium. When the decidua compacta is thin or absent, we speak of it as placenta accreta vera. When the villi penetrate into the muscle, we call the condition placenta increta. There may be partial or complete placenta accreta. In other words, only a part or the entire placenta may be firmly attached to the uterus. (Figs. 1 and 2.)

We must differentiate placenta accreta from adherent placenta. The big differential point is that in adherent placenta a plane of cleavage between the placenta and the uterine wall exists and is readily found. This is not so in placenta accreta.

The causes of placenta accreta may be summarized as follows: Repeated and vigorous curettage; manual removal of the placenta with one or more previous pregnancies, with resultant damage to the endometrium; submucous fibroids with atrophy of the overlying mucosa; endometritis as in a preceding postpartum infection; faulty position of the placenta as in placenta previa; pregnancy in a diverticulum of the uterus, for example, bicornuate uterus in which the endometrium may be

\* Read at the Beth David Clinical Society Meeting, February 9, 1942.

poorly developed; previous cesarean section. The placenta may imbed itself at the site of the scar in the uterus at which point there may be a poor decidual reaction. In patients with functional disturbances and sterility the administration of hormones or synthetic drugs having hormonal-like effects may cause changes in the endometrium, which would perhaps be a factor in an altered decidual reaction and thus contribute toward the development of placenta accreta.

The literature consists almost entirely of case reports. In 1933, Pfaneuf<sup>9</sup> grouped eighty-two collected cases under four headings of treatment: (1) Manual extraction; (2) vaginal hysterectomy; (3) abdominal hysterectomy, and (4) cesarean section.

The maternal mortality figures for these four methods of treatment are as follows:

No. of Cases	Method of Treatment	Maternal Mortality, Per Cent
36	Manual extraction	72
11	Vaginal hysterectomy	36
33	Abdominal hysterectomy	6—Method of choice
2	Cesarean section	0

In one of these cases a hysterectomy was done; the other patient was treated by intrauterine packing; both mothers recovered.

In a survey of the literature I have found only the two above mentioned cases of placenta accreta in which a cesarean section had been performed for placenta previa. The following is a report of a third case which may belong to that group called placenta previa cervicalis by DeLee. In this type of placenta previa the placenta grows down into the cervical canal where a poor and unsatisfactory decidual response takes place with resulting invasion of the trophoblast into the cervical tissue and abnormal mechanism of separation as described above for placenta accreta. As no placental tissue was palpated in the cervical canal in

this case, the diagnosis of placenta previa cervicalis is only presumptive in this instance.

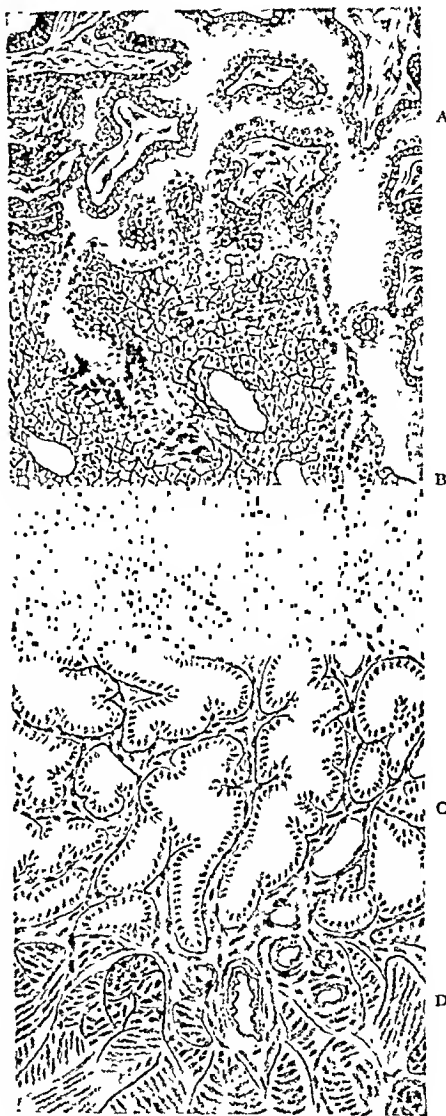


FIG. 1. Normal placental site. A, villi and intervillous spaces; B, decidua compacta; C, decidua spongiosa; D, myometrium.

#### CASE REPORT

Mrs. McA., thirty-eight years old, was admitted to the Beth David Hospital December 11, 1941. The past history is important. Ten years ago, September 23, 1931, she had a high forceps delivery with a second degree laceration, and a postpartum hemorrhage. The infant weighed nine and one-half pounds and died on the third neonatal day. The patient ran a febrile postpartum course and developed a pleural effusion of the left chest. She eventually

was discharged from the hospital, but had to be taken home by ambulance. Since that time she had one (early) pregnancy five years ago, which



FIG. 2. Placenta accreta. A, villi and intervillous spaces; B, one small area of decidua compacta; C, villi in direct contact with myometrium. (From Novak's Gynecological and Obstetrical Pathology, page 464. Philadelphia, 1940. W. B. Saunders.)

was terminated upon the advice of her physician because of her generally poor health; and three years ago she had a spontaneous five months miscarriage.

This patient was first seen by me September, 1941, at which time she was about five months pregnant. She had some slight painless vaginal staining for which she was treated by rest in bed and sedation. About three weeks later this painless bleeding recurred. A vaginal examination at this time revealed a cervix with an external os of two fingers. No placenta could be felt. She was about then six months pregnant.

A provisional diagnosis of placenta previa was made and usual conservative therapy was followed. She was quite well for about six weeks when a third episode of painless bleeding occurred. Upon getting out of bed one morning she passed about four ounces of blood. The patient was then referred to Beth David Hospital.

A soft tissue x-ray taken shortly after admission was diagnosed placenta previa. She was kept in bed in the hospital for three weeks, during which time she spotted a little occasionally. The reason for this temporization with a diagnosis of placenta previa was that the fetus appeared small and its viability was questionable and this thirty-eight year old woman was very anxious for a living baby. The patient was typed and a donor for a blood transfusion was secured. Under observation during these three weeks the gravid uterus became much larger and the fetus appeared distinctly viable. On January 2, 1942, when she was about thirty-seven weeks pregnant, the patient began to bleed again, passing about four ounces of blood. It was decided that she had been carried long enough with a diagnosis of placenta previa, and now with a good sized viable baby there was no reason for delaying operation; therefore, she was delivered by cesarean section that day.

Under local anesthesia a transcervical section was performed, and a living female infant weighing seven pounds two ounces delivered. The transverse incision in the lower uterine segment came right down upon the placenta, thus proving the diagnosis of placenta previa. After the delivery of the baby and upon attempting to remove the placenta I found that a part of it was firmly attached to the lower uterine segment in the region of the cervical os. Most of the placenta which lay under the uterine incision was removed with two or three pieces having to be torn away from the site of attachment. The uterus was packed with plain gauze and the operation completed in the usual manner. The patient was given an infusion and transfusion of 600 cc. of blood following operation. She was kept in the operating room. Her condition was fair, her pulse was rapid and she was watched for vaginal bleeding. About one hour after the operation some vaginal bleeding was noticed. Although not excessive it was important to control this in a patient who had lost some blood during the operation. The patient was then placed in the lithotomy posi-

tion and a vaginal speculum was inserted. The cervix was exposed and grasped with sponge sticks. Digital examination at this time revealed another piece of placenta about the size of a walnut lying over toward the right side of the cervix. This was grasped with another sponge stick and had to be torn away from its site of attachment. There was moderately free bleeding following this removal. The cervix and vagina were then tightly packed with iodoform gauze. The patient was watched in the operating room for another hour until the bleeding was apparently controlled.

Postoperatively there was a fairly sharp febrile reaction as expected. The patient's pulse remained rather rapid for two days. The vaginal packing was removed at the end of forty-eight hours and the intra-uterine packing after seventy-two hours. After the initial febrile reaction she ran a low grade fever which finally reached normal on the nineteenth day. This was due to an endometritis which cleared rapidly with simple bed rest and small doses of sulfathiazole. She was discharged on the twenty-third postoperative day in good condition.

#### DISCUSSION

Hysterectomy was considered at the time of operation. I decided against the procedure because most of the placenta had been removed and only several small pieces remained in the region of the cervix. Hysterectomy would have meant total abdominal hysterectomy, that is, the uterus and cervix would have had to be removed because the parts of the placenta remaining were in the cervix and not in the body of the uterus. A supracervical hyster-

ectomy would, therefore, have been a useless procedure and a total abdominal hysterectomy of a postpartum uterus at this time would have been too much surgery for this patient. In addition, the bleeding at the placental site was apparently controlled by the intra-uterine packing which remained dry during the closure of the uterus.

#### CONCLUSION

1. A case of placenta accreta in placenta previa treated by cesarean section is described.
2. The common causes of placenta accreta are mentioned.
3. Placenta accreta should be considered in any patient giving a history of repeated curettages or previous endometrial infection.
4. As a result of the increased number of cesarean sections placenta previa will probably become more common.

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# MASSIVE RESECTION OF SMALL INTESTINE

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THE following is the history of a patient on which a massive resection of the small intestine for a volvulus was performed. This patient was operated upon at the age of nine years. She survived the operation and during the past five and half years she has developed normally.

## CASE REPORT

Case No. 1249. W. S. D., aged nine years, a white, American, female child was admitted to the St. Francis Hospital, Peoria, Illinois, on September 21, 1936, under the care of Dr. C. E. Sibilsky, pediatrician. Her chief complaint was that of severe cramps in the abdomen. The following history was obtained from the child's mother: The child was a normal, full term delivery. Weight at birth was eight and three-fourths pounds. She was breast fed for one year. Even at this early date there was a tendency to constipation and glycerine suppositories and enemas were frequently required to give relief. She had the usual childhood diseases. She had suffered no injuries and no surgery was ever required. The family history was negative.

The child's present trouble began at the age of one year. This was attributed to the taking of more solid foods. After eating a meal one day she suddenly became stiff and pale, doubling up with colicky pain in the abdomen. Vomiting accompanied the attack. Similar attacks with cramping and vomiting had occurred periodically up to the present time. The attacks were more frequent during the early years of the child's life and she had as many as fifty attacks in a single year. In the past two or three years they had been decreasing in frequency and increasing in severity. The child had always been constipated and the mother stated that she believed her bowels were "paralyzed." Mineral oil and petrolagar had been given nightly for eight years.

The present attack of pain began on the afternoon of September 20, 1936. The onset was sudden and the patient complained of severe abdominal cramps in the region of the

umbilicus. The pain was quite severe in character and the paroxysms became more and more frequent and were accompanied by vomiting. An enema gave only temporary relief.

I saw this patient on the afternoon of September 23, 1936. This was two days after her admission to the hospital and approximately three days since the beginning of the attack of pain. An x-ray (Fig. 1) was taken at St. Francis Hospital the morning before I saw her. The following is the report by the roentgenologist: "The heart and aorta within normal limits. The posterior mediastinum clear. The excursions of the diaphragm normal. The esophagus showed no pathology. The stomach was normal in size, shape, and position. There were no filling defects on either curvature. The pyloric antrum was regular in outline. The duodenal bulb presented no pathology. The stomach showed a definite retention at the end of six hours, about one-fourth of the original contents remaining therein. There was motility of the barium meal at the end of twenty-four hours. There was definite retardation at the end of twenty-four hours. There was definite retardation of the barium meal in as much as it was still located in the small bowel. There was some small bowel dilatation with an acute angulation in the right side at the level of the fourth lumbar vertebra, and an attempt at serrated edges of the small bowel which was quite suggestive of small bowel obstruction."

Physical examination revealed a poorly nourished child of nine years. Her expression was quite anxious and she looked much older than a child of her age. She was quite emaciated. Her thighs were flexed on her abdomen and she complained bitterly of cramp-like pain. When asked where the area of pain was, she pointed to the region of the umbilicus. The abdomen was soft and there was no rigidity. Tenderness was not marked on deep palpation. No masses were felt. Examination was otherwise negative.

The white cell count was 54,000 and the red cell count 3,500,000. Hemoglobin was 70 per cent. Differential count: segs ninety-one; staff one; young none; eosinophiles none; basophiles

none; lymphoblasts three; mononuclears five. Urine was negative; temperature 101°F. and pulse 130 to 140.

A diagnosis was made of bowel obstruction with peritonitis. An immediate operation was advised and the patient was prepared for surgery. Two hundred and fifty cc. of citrated blood was given preoperatively. No preoperative medication was given because of the patient's condition. The operation was performed under cyclopropane anesthesia and started at 4:45 P.M. On opening the abdomen through a right rectus incision, the cecum was found up under the diaphragm on the right side. There was a volvulus of the small intestine extending from the cecum to what seemed to be the upper portion of the ileum. The bowel was black and degenerated and there was definite evidence of the usual peritonitis with gangrenous bowel. It is roughly estimated that it was necessary to resect from ten to twelve feet of the small intestine. However, because the bowel was so badly degenerated, it was difficult to measure it correctly. At the lower portion of the ileum there was a large diverticulum which may or may not have been the original source of the trouble. No attempt was made to make anastomosis because of the patient's condition. The terminal portion of what was thought to be the jejunum and a small cecal portion of the ileum were exteriorized.

The patient required a very small amount of anesthesia. The operation was completed in thirty minutes. Her condition was poor throughout the operation and the prognosis was guarded. Her pulse ranged from 130 to 160. She was immediately given a transfusion of 250 cc. of citrated blood and the transfusion was followed by intravenous glucose and saline.

The next morning she was somewhat improved. Her pulse ranged from 120 to 140. She was given 300 cc. of citrated blood and also intravenous fluids. That afternoon she suddenly became cyanotic and her respirations increased to thirty-six. There was marked distention of the abdomen. An intranasal Levine tube was inserted. By aspiration and vomiting, approximately four to six liters of liquid were obtained and the patient had immediate relief. A Wangenstein suction tube was inserted. On September 25, the patient's general condition was a little improved. The return through the tube was only slightly colored. Her temperature was 102.8°F. Hemoglobin was 48 per cent and

the white cell count was 8,800. Urine was negative. On September 26, she continued to show improvement. Intravenous fluids were given



FIG. 1. X-ray showing evidence of obstruction of small bowel before operation.

and the Wangenstein tube continued. The clamp which was left on the cecal portion of the ileum sloughed off. There was drainage from the upper loop. Her highest temperature was 101.8°F. Her hemoglobin was up to 63 per cent and the red cell count 3,370,000; the white cell count was 10,400. On September 28, there was no distention of the abdomen. The patient's highest temperature was 102°F. rectally. Her pulse ranged from 108 to 120. The cecal clamp was replaced. She was given sodium chloride by mouth. September 29, her general condition was good. She was given small amounts of fruit juice and jello by mouth. Her temperature was 99.6°F. On October 2, the patient was quite drowsy. Fluids were insufficient. There was a considerable amount of drainage from the jejunal loop. Fluids were given intravenously.

On October 4, a temporary artificial anastomosis of the loops by Y tubing was attempted but this proved unsatisfactory. The following day anastomosis by flanged glass tubing was done. There was passage of ileal contents into

the cecum for a brief period. The next day the cecal tube was removed and then re-inserted. Fluids were given intravenously and by mouth.



FIG. 2. Patient, five and a half years after operation, showing normal development.

There was still a large loss of ileal content from around the glass tube. There was obvious weight loss. On October 9, preparation was begun for anastomosis. Irrigation of the upper loop was done and a rubber dam was applied to protect the incision. On October 12, an ileocecal or questionable jejunal cecal end-to-side anastomosis with closure of the incision was done. The patient's general condition postoperatively was satisfactory. She was given 250 cc. of citrated blood postoperatively. Intravenous fluids were also given but nothing by mouth. On October 16, the patient's general condition was satisfactory. Intravenous fluids were continued. Her hemoglobin was 72 per cent and red cell count 3,540,000. Urine was negative. There was only a slight amount of drainage from the incision. She had several small liquid stools. On October 18, the patient was placed on a light soft diet. She had three to five stools in twenty-four hours. Her temperature was practically normal. On October 22, she had an occasional vomiting spell. She also had frequent loose stools. There was some separation of the incision. However, she seemed to be progressing satisfactorily. On October 28, the low fat, high protein, high carbohydrate diet with vitamins was increased. The patient's general condition was good. The stools were less frequent and more solid. On November 9, her condition continued good and she weighed forty-five pounds. She was able to be up in a wheel chair. She was

discharged from the hospital on November 14, 1936, the wound being entirely healed except for two small areas. Her general condition was



FIG. 3. X-ray of gastrointestinal tract five and a half years after operation.

good. She was advised to continue on the diet previously prescribed.

The patient made a good convalescence after her discharge from the hospital. She gained ten pounds in the first two months. I did not see her again until November 5, 1938, at which time she was getting along fine. She had gained a considerable amount of weight and her mother stated that she was better than she had ever been.

On September 22, 1941, five years after the operation, she came in for a check up at my request. Her appearance (Fig. 2) was that of a normal young lady. Her physical examination was negative except for a rather disfiguring scar on the abdomen. There was no evidence of a hernia. Her general health was good and she stated that she menstruates normally each month. She also stated that she had not been too careful about her diet. She does have two to three soft-to-liquid stools daily. She guards against taking laxatives.

A check x-ray of the gastrointestinal tract (Fig. 3) was taken at St. Francis Hospital. The

report of the roentgenologist is as follows: "Fluoroscopic examination of the chest negative. The esophagus was rather long and its distal end was close to the lesser curvature. The duodenal bulb was also close to the middle portion of the lesser curvature. The stomach emptied rather slowly but showed no defect. About two feet of the small intestine were visible. This portion of the intestine was normal in caliber and showed normal mucosal pattern.

"Films showed the configuration of the stomach as described above with no intrinsic defect. The duodenum followed the usual course. A moderate length of small intestine of normal pattern was visible in the middle portion of the abdomen. It was impossible to give an accurate statement of the length of the small bowel but it was judged to be near two feet in length. A film about fifteen minutes after barium was given showed only a small portion in the duodenum and proximal jejunum the remainder was in the stomach. At fifty minutes to one hour there was already barium in the cecum and ascending colon. The cecum was slightly more medial in position than usual. At two and one-half hours there was still a small amount of barium in the stomach and duodenum while the remainder was scattered throughout the small intestine and most of the colon. Hence, barium meal passed more rapidly through the intestine because of its short length but the motility of the various segments of gastrointestinal tract remaining was essentially normal for each individual area. The stomach was possibly a little slower to empty than the average."

*Impression.* Absence of most of small intestine (post-operatively); gastrointestinal tract otherwise negative.

Complete laboratory tests were also made. Blood chemistry: serum chlorides 643 mg. per cent; total proteins 7.25 per cent; albumen 5.4 per cent; globulin 1.85 per cent. Blood count: hemoglobin 72 per cent; red cell count 3,400,000; white cell count 5,800; color index 1.06. Differential count: segs fifty-three; staff three; young none, eosinophiles none; basophiles none; lymphoblasts forty; mononuclears four.

Urinalysis was negative. Urinary calcium twenty-four hours—232 mg. Feces examined for fat showed 23 per cent fat.

#### SUMMARY

I realize that I would not be reporting this case if the patient had not survived the operation. I also realize that no conclusions should be drawn from one case. However, there are certain observations which might be noted.

The following observations have been noted in this case:

1. There was a definite advantage in making anastomosis to the cecum rather than to the transverse colon.

2. The child has seemingly developed perfectly normal through a rather critical period of her life and the only apparent residual effect which could be accounted for, on the basis of the amount of intestine removed, is the frequent loose stools and the mild secondary anemia.

3. The blood chemistry in this particular case is normal five and a half years after the operation.

4. Although an accurate measurement of the bowel removed was not made, I believe that the estimate of ten to twelve feet is quite conservative. An attempt to verify this was made by recent x-ray.

For an extensive and very comprehensive review of a collection of cases of massive resection, you are referred to an article by Dr. H. E. Haymond.<sup>1</sup>

The author wishes to express his appreciation to Dr. R. I. Clary, former associate, and to Dr. C. E. Sibilsky, who referred the case, for their assistance in the postoperative care of the patient.

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# HEMORRHAGIC SOFT TISSUE SARCOMAS\*

## REPORT OF TWO UNUSUAL CASES

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TWO tumors with unusual characteristics are reported, both occurring in the upper extremity. These are of clinico-pathological interest because of their obvious soft tissue origin, their similarity in their tendency to extreme hemorrhagic necrosis such as is seldom seen except in telangiectatic osteogenic sarcoma (malignant bone aneurysm), their obvious possibilities of extensive fluid-like spread along fascial planes, and the fact that their outstanding characteristic was their resemblance clinically, and in one instance anatomically, to a large hematoma. On sectioning, the tumors were literally extruded in a gush of fluid blood leaving large cavities lined with fibrin and with but few areas of tumor cells. In one instance the normal tissues surrounding the fluid mass stood out as though exposed by anatomic dissection (Fig. 1) and the residual cavities, when further exposed, appeared to be filled with fluid, largely hemolyzed blood with some small clots in the dependent portions. In both cases extensive intratumoral hemorrhage had contributed to marked anemia.

### CASE REPORTS

CASE 1. A seventy-two year old colored male, a native of the Virgin Islands, and by occupation a sugar planter, was admitted to the Memorial Hospital on September 15, 1937, with his chief complaint a swelling of the arm. There had been no previous serious illnesses. The family history was irrelevant. In December, 1936, the patient noted a painless, soft, fluctuant swelling of the right forearm. He was afebrile and the swelling did not interfere with function. The forearm gradually increased in size and by March, 1937, the swelling seemed to be pointing and almost ready to rupture. It was then incised by the family physician at its most fluctuant point, obviously under an

erroneous diagnosis of abscess. There was a profuse discharge of blood, serum and slough.

Four months later the patient consulted a second physician. At this time he was in a critical condition because of the continuous oozing of blood and because of secondary infection. A submitted report of the physical examination made July 2, 1937, is as follows: "Patient is a short, thick, obese man of about 70 years of age, pallid, weak, and afebrile. There is a fusiform swelling of the right forearm. The wrist and elbow joints are not involved. There is slight edema about the wrist, but no swelling of the dorsum of the hand. There is no loss of function of the fingers. The arm above the elbow shows some edema. The skin of the forearm is smooth and soft. There are no nodules or points of tenderness. There is no local heat. From two holes in the skin oozes a serosanguinopurulent discharge. The margins of the openings show very hypertrophic, soft, sloughing, friable tissue. Digital examination of the cavity shows it to extend the length of the ulna. The surface of the bone is roughened. There appears to be no invasion of the skin. Roentgen examination shows a layer of new bone along the entire shaft of the ulna, and also along a part of the radius. There is no erosion of the cortex and the medulla appears normal throughout. Incontinence of bladder and rectal sphincters has been present for 45 days. Laboratory: Kahn negative; RBC 1,300,000; WBC 9,100; urine negative. On July 14 the extremity was amputated through the middle third of the humerus. Convalescence was uneventful. Recurrence in the amputated stump was noted September 5, 1937. The patient was sent to the Memorial Hospital for further treatment."

Physical examination on September 15 showed a well developed, obese, seventy-two years old negro male who appeared chronically ill. Head, neck and lungs were negative. Heart: A loud systolic murmur was heard over the aortic area. The abdomen was obese, genitalia atrophic, reflexes hyperactive, lymph-nodes not

\* From the Pathology Laboratories, Memorial Hospital, New York City.

enlarged. *Local lesion:* The right arm had been amputated about the midshaft of the humerus; the wound was well healed. The skin of the

showed muscles intact, connective tissue edematous, and here and there, over a wide area, some soft, friable, brick-red material resembling



FIG. 1. Amputated upper arm of patient in Case 1. The tumor cavity has been opened through a longitudinal incision. Note blood vessels and nerves in the center of the cavity as though carefully dissected. The cavity is free of tumor other than the cells adherent to and growing in the wall. A section of the humerus has been removed, exposing the medullary cavity.

stump was shiny, tense, edematous and reddened, with dilated superficial veins. Fluctuation was present over the lower portion. There was induration extending well up into the axilla and over the head of the humerus. There were no palpable axillary lymph-nodes. Roentgen examinations of the lungs and shoulder were negative for pulmonary metastases or primary bone tumor. *Laboratory findings:* red blood cells 2,528,000; white blood cells 9,200; urine showed a trace of albumen and many pus cells.

*Treatment.* The patient was given a pre-operative course of x-ray therapy. Between September 16 and 24, through an anterior port measuring 21 by 10.3 and a posterior port 15.6 by 17.8, he received 400 R times 4 (factors, 200 kilovolts,  $\frac{1}{2}$  mm. cu. filter, 50 cm. TSD). One port was treated daily. Under ether anesthesia, an interscapulothoracic amputation was performed on September 29. A transfusion of 500 cc. citrated blood was given before and again immediately following the operation. Convalescence was uneventful.

*Pathology.* On admission, the patient presented for study the entire specimen of his previously amputated arm fixed in formalin. Examination of this specimen showed an upper extremity amputated through the midhumerus. There was a through-and-through incision of the skin, apparently made with the idea of evacuating pus. Dissection of the forearm

formalin-precipitated blood. This material had no definite anatomic relation to nerve, muscle or bone, and no bursae were identified as sites of origin. The material in one area extended down through periosteum and was continuous with bare bone. Throughout almost the entire length of the ulna, the bone cortex was thickened, elevated and irregular, like a callus in old osteomyelitis. The medullary cavity was small in diameter; the marrow was hyperplastic. An additional tumor apparently removed from the amputated extremity was received separately and looked like a mass of fixed blood clot.

Examination of the specimen removed on September 29 was of an interscapulothoracic amputation of the stump of the arm. There had been a previous amputation a little below the midhumeral region, 20 cm. of the humerus remaining. The stump was well healed. The arm was enormously edematous, tense and fluctuant. On sectioning, the entire length of the humerus from the point of amputation to the glenoid was surrounded by a cavity containing at least one liter of fluid blood, only the lower dependent portion being clotted. The hemorrhage had separated nerves and vessels as if by anatomic dissection. Numerous pockets of hemorrhage were traceable through muscle planes, and over part of the humerus the periosteum was exposed and roughened, as in the bones of the forearm previously described. Smears made from the fluid showed numerous

tumor cells. In the axilla there was some soft hemorrhagic tissue, which seemed to lie within the axillary fat and was certainly metastatic

pounds in weight; she denied any cough, hemoptysis or other complaints.

Physical examination revealed the patient to



FIG. 2. Arm of patient in Case II opened by a longitudinal incision through the biceps muscle. Note the large cystic cavity, the wall of which is covered with necrotic tissue, fibrin, blood and tumor cells.

disease. There were some soft pinkish lymph-nodes, uninvolved by tumor.

Local recurrence was noted beneath the skin flaps in January, 1938. The patient, however, continued in good health until June, from which time onward he expectorated blood and became progressively worse. The local recurrence, too, became fluctuant. He died at home September 4, 1938, twenty months after the clinical onset of his disease. No autopsy was obtained.

**CASE II.** A forty-eight year old Russian housewife was admitted to the Memorial Hospital with a chief complaint of tumor of the left arm. The family history was negative. Past history described a supravaginal hysterectomy, presumably for fibromyoma, three years before the present admission.

Nine weeks before admission a friend grasped her left arm and she experienced considerable immediate pain. Prior to this she had noticed no tenderness or swelling. Immediately following this alleged injury, the arm became swollen and painful. She consulted her family physician who prescribed diathermy and infra-red treatments three times a week for three weeks. The swelling and pain became more marked and she was hospitalized in another hospital where an exploratory operation was performed. The tumor encountered was described as being in such a degenerated condition that it could not be removed. She was given two deep x-ray therapy treatments over the arm and then referred to this institution. She had lost five

be a well developed, moderately obese, apprehensive, white female about forty-seven years of age. Head, neck, lungs, heart and breasts were not remarkable. The abdomen showed a well healed scar. The cervix uteri was soft and boggy; no fundus was palpable. There were no enlarged lymph-nodes. Reflexes were normal. *Local lesion:* In the region of the left biceps there was a large, irregular, firm, slightly tender mass involving the anterior half of the arm. The mass extended from the cubital fossa to the axillary fold and measured approximately 10 by 16 cm. There was a linear scar over the center of the mass. In the scar were two ulcerated areas, measuring  $2\frac{1}{2}$  cm. in diameter, from which oozed a small amount of purulent discharge. The mass was movable over the underlying humerus. There was definite skin attachment. The circumference of the left arm, 10 cm. above the condyle, measured 35 cm.; the right measured 29 cm. There was some limitation of motion of the left shoulder due to pain. There did not appear to be involvement about the shoulder joint; axillary, supraclavicular and cervical lymph-nodes were not enlarged. Roentgen examinations of the chest and humerus were negative for pulmonary metastases and bone involvement. Laboratory findings: red blood cells 2,848,000; white blood cells 8,200; urine negative.

*Clinical Course and Treatment.* On August 17, 1938, an interseapulothoracic amputation of the left upper extremity was performed. The

patient received a transfusion at the time of operation and again on August 20. Convalescence was slow but otherwise uneventful. On December 19, 1938, she complained of pain over the tuberosity of the right ischium. Local, pelvic and rectal examinations as well as roentgen studies of the pelvis and femur were negative. On January 16, 1939, there was a palpable tender mass in the right buttock. Aspiration biopsy of this mass was positive for malignant tumor. She received eight deep x-ray therapy treatments of 200 R each (factors, 200 kilovolts,  $\frac{1}{2}$  mm. eu, filter, 50 cm. TSD) through a port 13 by 13 cm. centered over the mass. The pain and the mass in the buttock disappeared. On March 10, 1939, there were extensive metastases to the lungs and the left femur. The patient died at home April, 1939. No autopsy was obtained.

**Pathology.** The specimen was a left upper extremity, including a portion of the clavicle and the entire scapula with the scapular muscles attached. Situated on the anterior lateral aspect of the arm, opposite the biceps muscle was a raised tumor mass. There was an old incision directly over the mass and in the scar was an ulcerated area 4 cm. in length. The skin was thin and ecchymotic and the tumor mass felt soft and fluctuant, suggesting a diffuse hematoma.

In the axilla were six or more lymph-nodes, the largest of which measured 2 cm. in diameter and on gross section appeared suspicious of metastatic tumor, although subsequent study showed it free of disease. Section of the tumor revealed no attachment to bone. It was almost completely confined to the belly of the biceps muscle and measured 15 by  $8\frac{1}{2}$  by 6 cm. The tumor was sectioned in a longitudinal direction and found to consist of a cystic cavity filled with old blood clot and degenerate, necrotic tissue. (Fig. 2.) There was no evidence of perforation posteriorly. There was some evidence of infiltration distally along the fascial planes toward the biceps tendon.

In neither of these cases may a histogenetic diagnosis of the nature of the tumors be rendered with certainty. Both tumors are clearly primary lesions. That of the second patient evidently arose in the belly of the biceps muscle and is in all probability a myosarcoma, although there is little confirmatory evidence to be derived from sections on account of the extreme hemorrhagic necrosis. Although this hemor-

rhagic liquefaction was grossly more extensive in the tumor of the first patient, nevertheless, somewhat more intact tumor was available for histologic study. In this instance the tumor may perhaps best be described by stating that it resembled a highly malignant telangiectatic osteogenic sarcoma in spite of its evident soft part origin. Large blood spaces were lined with hyperchromatic tumor cells with enormous single and multiple nuclei and with abundant acidophilic cytoplasm often filled with droplets, masses of red blood cells and hematogenous pigment. In better preserved areas, the growth appeared to be in the form of syncytial masses of rather uniform, medium-sized cells interspersed with tumor giant cells. Epulis-type giant cells, rare in the first case, were exceedingly numerous in the second and such cells again add to the tumor's resemblance to telangiectatic osteogenic sarcoma. In the tumor of the first patient were areas where erythropoiesis seemed to be occurring. The first tumor is classed provisionally as fascial sarcoma; the second as myosarcoma.

#### SUMMARY

1. Two extremely hemorrhagic soft tissue sarcomas\* of the upper extremity are reported, one tentatively classified as fascial, the other as myogenic sarcoma.
2. These are of interest because of their clinical resemblance to hematoma due to their extensive hemorrhagic necrosis, the marked extent of fluid invasion in one instance along fascial planes, and the marked anemia caused by these tumors.
3. Their microscopic structure simulated, in properly preserved areas, telangiectatic osteogenic sarcoma, despite their obvious soft tissue origin.
4. The extreme hemorrhagic liquefaction, especially in the first case and particularly the degree of anemia presented by both patients suggest the presence of hemolytic properties resident in the tumors, since neither tumor revealed evidence of infection sufficient to explain the picture.

\* Case 1 is presented through the courtesy of Dr. Bradley L. Coley. Case 11 is from the service of Dr. George T. Pack.

# FISH BONE PERFORATION OF THE JEJUNUM\*

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FISH is an almost universal food, and fish bones are undoubtedly ingested rather frequently. The number of swallowed fish bones, and the proportion of these that cause perforation or penetration of the bowel is obviously impossible to determine. Reports of such perforations of the gastrointestinal tract are relatively uncommon. The earliest recorded instance that has come to our attention was in 1841.<sup>1</sup> and we have been able to find only forty-three recorded instances since that time. Carp<sup>2</sup> collected forty-eight cases of swallowed foreign bodies from the New York Presbyterian Hospital files from 1915 to 1926. Of these, two perforated the gastrointestinal tract, one fish bone and one chicken bone. With the exception of a group of six cases described by Ginsburg and Beller,<sup>3</sup> these reports have been almost entirely of isolated instances.

Of the forty-three instances of perforations by fish bones, the stomach was involved in three, the small bowel in twelve, the colon in ten and the rectum in eleven. Two perforated a Meckels' diverticulum, two the appendix and in three the site of perforation is not reported.

Several reasons are advanced for this relative infrequency of perforations. Many bones are caught in the pharynx and not swallowed. Of those that are swallowed the majority are probably well surrounded by intestinal content and rendered harmless. Smaller bones may be digested, or at least softened, and rendered unable to perforate the bowel wall.

A bone that becomes lodged in the bowel mucosa may penetrate through the intestinal wall either by direct trauma or by pressure necrosis. The inflammatory process set up by pressure necrosis may aid in digestion of the bone. This process probably occurred in the case which we are

reporting. In this instance the process led to an abscess of the bowel wall and perforation as well, but it seems possible that at times the bone may be sloughed back into the lumen of the bowel and further penetration prevented.

## CASE REPORT

B. K., a twenty-five year old married woman was admitted to the surgical ward with a history of generalized abdominal pain for five hours. The pain had gradually increased in severity especially in the right lower quadrant. There was no history of dietary indiscretion, no nausea or vomiting. There was a past history of occasional right lower quadrant pain, which had been diagnosed as a "chronic appendix." The rest of the history was not pertinent.

Physical examination revealed a well developed and nourished woman obviously in pain, with a temperature of 100.2°F. rectally, a pulse of 92, and respirations of 22. The significant physical findings were limited to the abdomen. It was resistant to palpation, particularly on the right side. Tenderness was diffuse and marked. Rebound tenderness was exquisite over the right lower quadrant. No masses were palpated. Pelvic examination revealed nothing abnormal. There were 24,000 leucocytes per cu. mm. of blood. Urinalysis and examination of vaginal smears revealed nothing abnormal.

The preoperative diagnosis was acute appendicitis and the abdomen was explored through a muscle splitting incision. When the peritoneal cavity was opened, a moderate amount of cloudy fluid was encountered. The peritoneal surfaces were injected, as was the appendix. Exploration revealed an indurated area, 3 mm. in diameter, in the distal jejunum. This grey green area was the site of a pin point-sized free perforation of the bowel wall. It was completely excised and the defect sutured. The appendix was removed and the abdomen was closed without drainage. The patient left the hospital on the eighth postoperative day after an uneventful convalescence.

\* From the Department of Surgery, Michael Reese Hospital, Chicago.

Questioning of the patient during her hospital stay revealed that two weeks before admission the patient ate fish. A bone lodged in

abdominal abscess; (3) intra-abdominal inflammatory tumor; (4) abdominal wall inflammatory tumor; (5) abdominal wall



FIG. 1. Showing fragment of bone within localized abscess in wall of jejunum.

her throat and it took about an hour to dislodge it by swallowing, eating bread crust, etc.

Pathologic report of the excised tissue was "Recent abscess in the wall of the small intestine with a fragment of bone in the wall. Acute perijejunitis." (Fig. 1.)

This case is interesting for several reasons. It illustrates the well known fact that bones may perforate the bowel wall by pressure necrosis and infection as well as by direct trauma. The finding of the bone fragment within the bowel wall indicates that bone destruction may occur as a result of the inflammatory reaction and digestive processes.

The necrosis and infection lead either to a free perforation as in this instance, or to a more gradual penetration with walling off of the involved loop of bowel by other intra-abdominal structures, which leads eventually to all the bizarre clinical pictures and symptomatology which have been recorded in the literature. It is easily understood why the time element varies so greatly between ingestion of bone and the start of symptoms. The various clinical types of perforations have been classified by Ginsburg and Beller:<sup>3</sup> (1) Acute perforation with peritonitis; (2) localized intra-

abscess; (6) perforation with inflammation and obstruction in the hernial sac. The reason for occurrence of these groups is evident.

#### SUMMARY

1. The case report illustrates free perforation of the ileum by a fragment of fish bone not large enough to be recognized grossly.
2. Pressure necrosis and infection of the bowel wall by a bone or foreign body is well illustrated.
3. The possibility that most perforations occur through this process is suggested.
4. The possibility that digestion of the bone by the inflammatory process initiated may in itself be a mechanism to prevent perforation of the bowel wall by loosening the bone and sloughing it back into the bowel lumen is advanced.

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# EXTERNAL PERFORATION OF THE ESOPHAGUS\*

## CASE REPORT

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WHILE internal perforations of the esophagus are relatively common, perforations from without are rare. This is due to the deep seated position of the esophagus, its rather small diameter in the resting, collapsed state and to the protection of the surrounding structures, particularly the spinal column. Because of their rarity these cases always present a problem in treatment since any one man's experience is usually too meager to form a basis for the proper management when a case presents itself. The primary consideration in these wounds is the control of the infection which develops in the lacerated area, to prevent mediastinitis or to treat it if it develops.

Jensen,<sup>1</sup> who reviewed four cases collected from the literature<sup>2-5</sup> and added one of his own, attributed the good result obtained in his case to an operation exposing the lacerated esophagus and inserting a drain, thus establishing, he believed, more adequate drainage; although he cites three cases which healed without operative intervention.

## CASE REPORT

A white female, aged seven years, was admitted to the Milwaukee County Emergency Hospital on July 28, 1941. She had been running on a fence with a stick in her hand and had fallen, the stick perforating her neck. The stick was immediately removed with very little hemorrhage.

Examination revealed her to be very apprehensive. Her respirations were short and jerky. Her skin was pallorous. There was a laceration 2 cm. long just lateral to the sternal attachment

of the left sternocleidomastoid muscle through which blood-tinged saliva oozed when she swallowed. Immediately surrounding the laceration there was an area of subcutaneous emphysema for a radius of about 2 inches.

The abdomen was tender throughout and held rather rigidly. The pulse rate was 110 and the quality was good. The temperature was 100°F., rectally.

A prophylactic dose of combined gas gangrene and tetanus antitoxin was given. A stomach tube was passed through the nose into the stomach. A hot compress was placed over the wound. Sulfathiazole, 1 Gm. three times daily, was administered; the tablets being crushed and placed into the tube feeding.

Five hours after admission, the temperature was 102°F. and remained at about that level throughout the entire next week. There was no undue pain or tenderness in the neck and the abdominal distress rapidly disappeared. The next morning the blood count was: white blood cells 12,700 and red blood cells 3,940,000. The emphysema showed no tendency to spread.

It was found advisable to divide the tube feedings into very small amounts and to give them every hour as too large quantities of fluid given at one time caused vomiting, some of the vomitus escaping through the neck wound.

After forty-eight hours the wound began to discharge pus mixed with saliva. A lateral x-ray of the neck revealed no abnormalities except the emphysema. The x-ray report on the chest was as follows: "There is a broadening of the mediastinal shadow, especially to the right with haziness in the inner lung field on this side. There is some interstitial emphysema of the left side of the neck. Impression: early mediastinitis."

Repeated chest x-rays on August 4th showed some increase in the cloudiness of the mediastinal shadow. (Fig. 1.) The patient, however,

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exhibited none of the clinical signs or symptoms of mediastinitis except the elevation in temperature which was not of the septic type. Because

to repair the esophagus would have meant a fairly extensive neck dissection with more resultant trauma to tissue and with a



FIG. 1. Roentgenogram of the chest showing the widening of the mediastinal shadow and the haziness in the right inner lung field. The two white streaks show the stomach tube in the esophagus and externally from the nose.

of the patient's lack of symptoms it was believed that, if a mediastinitis was present, the wound itself afforded adequate drainage and that the chemotherapy was preventing a fulminating mediastinitis.

On August 5th, the emphysema was gone and the temperature returned to normal. On August 7th, fluids were given by mouth as the fistula was closed and August 9th, twelve days after the injury, the stomach tube was removed. Figure 2 shows the patient after the wound had healed. On September 1st, a fluoroscopy of the esophagus using barium sulfate showed no abnormality and the mediastinal shadow was normal.

#### DISCUSSION

The emphysema occurring immediately after the accident as in this case should not alarm one, since it is due, as Holinger<sup>6</sup> states, to the aspirating effect of the negative intrathoracic pressure during inspiration.

It was believed that there was nothing to gain by operative interference. To attempt



FIG. 2. Three weeks after the injury. The healed neck wound is indicated by the arrow.

possible pocketing off of infection. As far as the treatment of the infection was concerned, it was believed that the injury had performed a perfect cervical mediastinotomy with very adequate drainage. We are of the opinion that the chemotherapy aided in preventing a fulminating mediastinitis.

#### SUMMARY

A case of external esophageal perforation treated conservatively is reported with a brief review of the literature.

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# COCCYGEAL HERNIA

## CASE REPORT

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**C**OCCYGEAL hernia is a rare type of postoperative hernia; it is not mentioned in textbooks of surgery even among the rare hernias. This hernia does not occur congenitally and there is no case on record in which a hernia has occurred in this region where there has not been performed a previous operation for removal of the coccyx. In reviewing the literature I was able to find only two other cases reported.

### CASE REPORT

The patient, a white married woman, aged twenty-eight, was admitted to the Birmingham Baptist Hospital on August 3, 1939. She injured her coccyx in March, 1937, and following this injury she had considerable pain in the coccygeal region. Five months after this injury her coccyx was removed in another hospital following which she had an infection of the sutures but no general breaking down of the wound. After recovery from this operation she was free from symptoms for approximately twenty months; then the structures gradually broke down and on April 1, 1939, she first noticed a protrusion in the region of the coccyx. Three weeks after the protrusion occurred she began to have a dull pain in this region when sitting or standing. She always had good control of her bowels and no constipation had been present. She had one child which was six years old; her menstrual periods had been normal. The family history was irrelevant.

She was well developed and well nourished. The systolic blood pressure was 115, the diastolic blood pressure was 75, the pulse rate was 90, and the respiratory rate was 20. The rest of the examination revealed that there were no abnormal findings except in the coccygeal region where a well healed scar was present in the midline. When the patient was sitting or standing there was also present in this region an oval protruding mass 5 to 6 cm. in diameter. (Fig. 1.) This mass was soft, easily reducible

and on coughing a definite impulse could be elicited. When the patient was put in the recumbent position the mass entirely disappeared.

The laboratory report showed that the urinalysis was negative. The hemoglobin was 78 per cent, the red blood count was 4,000,000 and the white blood count was 9,000 with 72 per cent neutrophils and 28 per cent lymphocytes.

A diagnosis of coccygeal hernia was made and on August 4, she was operated upon by Dr. Earle Drennen. The operation was done under spinal anesthesia with the patient in the prone position.

She was dismissed from the hospital on August 9, and was to continue rest in bed at home. Her convalescence was uneventful except for a small amount of serous discharge from the wound. One year after the operation the patient was in good condition and had no recurrence of the hernia or the symptoms.

Pagenstecher reported a case of coccygeal hernia in 1930, and Nichols and Herring reported a case in 1933. Of these three cases reported (including the case reported here) two were females and one was a male. (Table 1.) The age of these patients was fifty, thirty-eight and twenty-eight, respectively. In each case there had been done a coccygectomy previously. In the first case the time between the removal of the coccyx and the occurrence of the hernia was seven months, in the second case it was seven years, and in the third case it was twenty months. The duration of the hernia in the first case was four months, in the second case six weeks, and in the third case four months. Two of the cases had pain in the coccygeal region especially when sitting, but one case complained of only the sensation of the protrusion of her bowels and the sensation of sitting on her bowels.

In the second case the hernia started after a subsequent injury to the coccygeal region following the removal of the coccyx. The anal sphincter was functioning properly in all three cases, for no incontinence was present in any case. There was no strangulation of the hernia present in any case. The final result following the repair of the hernia was good in all three cases with no recurrence of the hernia up to the time of the last observation.

stripped from the lower end of the sacrum during the removal of the coccyx, that would greatly increase the tendency for the formation of a hernia.

ANATOMY

The coccyx which has the attachment of many important structures forms an essential link in the supporting mechanism of the posterior pelvic wall. Beneath the skin and the two layers of superficial fascia the main

TABLE I  
OUTLINE OF CLINICAL FINDINGS IN CASES OF COCCYGEAL HERNIA

Author	Age	Sex	Symptoms	Length of Time between Removal of the Coccyx and the Occurrence of the Hernia	Condition of the Wound Following Removal of the Coccyx	Duration of Hernia	Final Result
1. Pagenstecher . . . .	50	Female	Presence of the sensation of protrusion of the bowels and the sensation of sitting on the bowels	7 mos.	Drainage for 3 mos.	Less than 4 mos.	No recurrence after 9 mos.
2. Nichols and Herring.	38	Male	Dull aching pain in lower end of spine especially when sitting	7 yrs.	Drainage for few days but healing by first intention	6 wks.	No recurrence after 3 mos.
3. The Author . . . . .	28	Female	Dull pain in coccygeal region when sitting or standing	20 mos.	Infection of the sutures	4 mos.	No recurrence after a year

The anatomic structures in this region are very strong and dense and it is not probable that a hernia would occur here spontaneously unless it followed the surgical removal of the coccyx or severe traumatic laceration of this region.

The etiology of coccygeal hernia is essentially the same as that of postoperative hernia in the anterior abdominal wall. Infection and the improper approximation of the important muscles and fascia are the chief causes. In each of the three cases studied here there were signs of some wound infection. In the first case there was drainage of the wound for a period of three months. In the second case there was drainage of the wound for a number of days, but the wound healed by primary intention. The third case according to the history had an infection of the sutures. If the attachment of the muscles and fascia is

structures are the glutei maximus muscles with their covering sheath, the fascia lata. These are attached to the sides of the coccyx, lower part of the sacrum, and the sacrotuberous ligaments. Anteriorly to the origin of the gluteus maximus on the coccyx the sacrotuberous and sacrospinous ligaments are attached, and in front of these ligaments is the point of insertion of the coccygeus muscle which helps to close the posterior part of the pelvic outlet.

Of the structures which help to support the anal diaphragm the coccyx gives insertion on its anterior surface to the levator ani muscles; the two pubococcygei muscles unite forming a fibromuscular band which lies on the raphe of the iliococcygei muscles. Superficially to the levator ani muscles the apex of the coccyx gives attachment to the anococcygeal raphe which extends from the tip of the coccyx to the posterior margin

of the anus and gives attachment to the circular fibers of the sphincter ani externus. Closely associated with the levator ani muscles is the pelvic fascia.

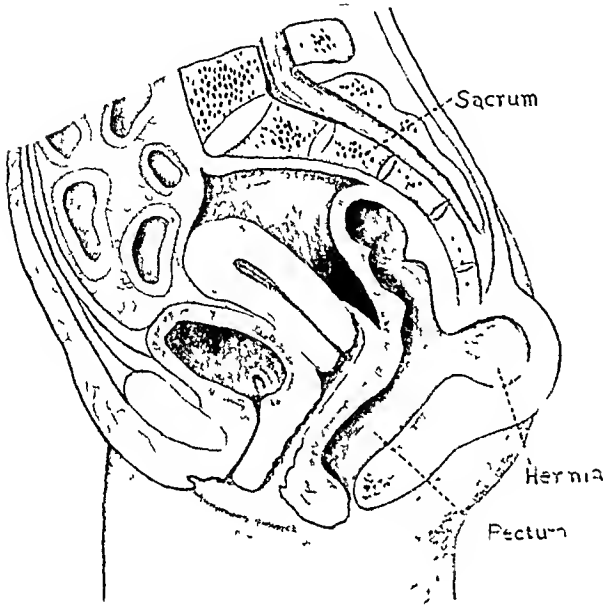


FIG. 1. Drawing of a median sagittal section illustrating a coccygeal hernia. The coccyx is absent and bowel is protruding through the coccygeal region.

A hernia in this region protrudes through the triangular area which was occupied previously by the coccyx. It is bounded above by the lower end of the sacrum and on each side by the gluteus maximus muscle. The apex of the triangle extends into the levator ani muscles. Externally, it is covered by skin and superficial fascia.

#### OPERATIVE PROCEDURE

The patient is put in the prone position and a midline incision is made in the skin directly over the mass. Upon extending this incision down through the subcutaneous tissue the posterior surface of the bowel is brought into view. There usually is no peritoneal sac present, for the posterior surface of the ampulla of the rectum which

is not covered by peritoneum forms the protruding mass. If no peritoneal sac is present, the protruding mass may be inverted by simple plication. The posterior part of the levator ani muscles is freed and any separation that has occurred in them is sutured. The gluteus maximus muscle with its fascia and sacrotuberous ligament are freed on each side and these structures are firmly sutured in the midline. In the lower end of this suture line some of the sutures are so placed as to include the levator ani muscles and thus help to support the anal diaphragm. The superficial fascia and skin are closed in layers.

#### CONCLUSIONS

A case of coccygeal hernia is reported and two other cases are reviewed from the literature. The following conclusions are drawn from a study of these three cases:

1. Coccygeal hernia is an incisional hernia which occurs only following the surgical removal of the coccyx or severe traumatic laceration of the coccygeal region.
2. A postoperative wound infection is a definite etiologic factor in the formation of this hernia.
3. The length of time between the removal of the coccyx and the occurrence of the hernia has been from seven months to seven years.
4. A hernioplasty done by the dissection of the important anatomic structures and their approximation in layers gives a good result.

I want to express my gratitude to Dr. Earle Drennen for granting me permission to publish his private case.

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# New Instruments

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## REFRIGERATION BOX FOR AMPUTATION\*

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ICE anesthesia for amputation of extremities is now being regarded as a very satisfactory procedure for the debilitated, toxic and poor risk patient. Crossman and Allen have a convincing series of amputations performed under ice anesthesia in which the absence of shock is a notable feature. We have had a similar experience in a smaller series of cases. One case in particular illustrates the effectiveness of ice anesthesia in decreasing the shock of operation as well as the shock of anesthesia in sick, debilitated, aged individuals.

### CASE REPORT

N. B., sixty-seven years of age, was admitted to Dr. Fredrick W. Bancroft's service at the Beth David Hospital on July 24, 1941, with the diagnosis of diabetic gangrene of the left foot and lymphangitis extending above the ankle. The patient ran a septic temperature during the entire preoperative period. The cardiac status was so poor that any mental excitement or sitting up in bed produced cyanosis and marked dyspnea. Aware of his bad cardiac state, a very brief inhalation anesthesia was given on two occasions, once for amputation of the toe and the other time for incision and drainage of the plantar fascia. On both occasions the patient went into acute cardiac failure with pulmonary edema. He required heroic treatment for his resuscitation. On September 29, 1941, one week after the incision and drainage, the patient was prepared for a mid thigh amputation by refrigeration in our box. He not only withstood operative procedure without discomfort, pain or cardiac

embarrassment but was able to get into a wheel chair the afternoon the day of operation for the first time in two months.

The method that we originally used to produce refrigeration was to place a rubber sheet under the affected extremity, pack ice around the leg and then enclose the whole in a rubber sheet. The melting ice wet through bed sheets and mattresses and offered a difficult nursing problem. The transportation of the patient with his leg wrapped in ice to the operating room was also inconvenient.

The box we have devised and used obviated these difficulties. The box is made of wood, is rectangular in shape and measures thirty-six inches in length, fifteen inches in width and fourteen inches in height. The lining is of galvanized tin. The bottom of the box is round and semicircular and accommodates two rockers, one near its proximal end and one near its distal end. The rounded bottom and rocker construction give the box a cradle-like motion enabling the patient to change his position in bed. The proximal rocker is four inches in height and the distal rocker is two inches in height. The difference in height of the two rockers produces an incline permitting easier drainage of the water from the melting ice. In the proximal end of the box there is a round opening measuring ten inches in diameter sufficiently large to accommodate the largest thigh. The upper section of the opening is made removable, enabling one to place the leg in the box without having to guide the foot and leg through the opening of the box.

\* From the Surgical Service of Beth David Hospital, Dr. Frederick W. Bancroft, Surgical Director.

The removable piece is then replaced, thus completely encircling the thigh. The extremity is further sealed within the box

ing superficial anesthesia so that the application of the tourniquet may be painless. After the tourniquet is applied, the

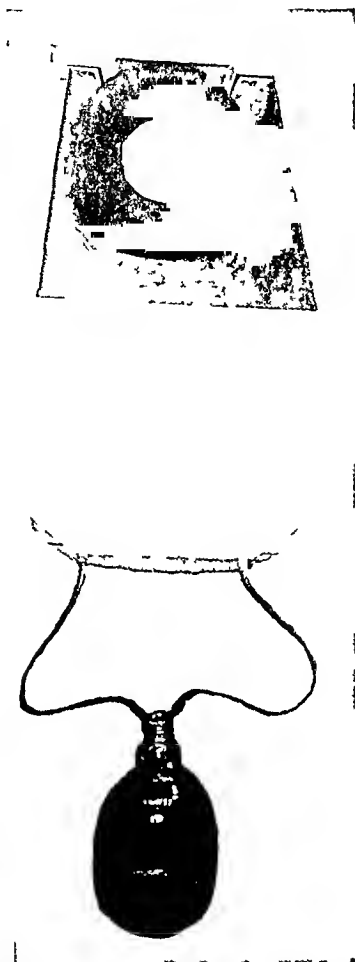


FIG. 1. Refrigeration box without cover. Removable upper section in proximal end of box is in place. This section is removed when extremity is placed in box. Outlet tubes for drainage are at distal end of box.

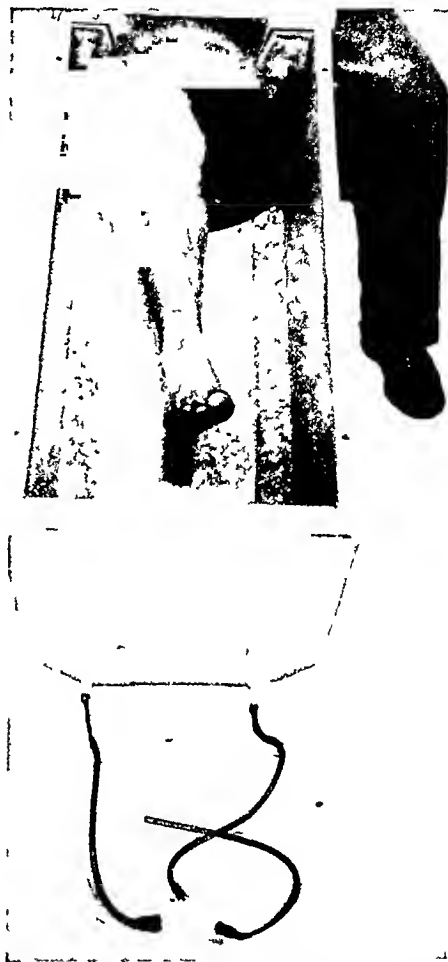


FIG. 2. Extremity in place; upper section in place. Extremity in midthigh amputation would enter box to level of groin. Tourniquet around the limb not depicted; rockers on bottom of box not visualized. Galvanized tin lining within wooden box with rounded bottom can be noted.

by slipping a rubber inflatable ring over the leg and placing it flush against the opening. On the floor of the distal end of the box there are two outlet tubes permitting the drainage of water so that ice particles alone surround the leg. The box is covered by a lid which is fastened in place by two hooks on each side.

The technic we have employed consists first of placing three ice bags to the site at which the tourniquet is to be applied. These are left in place for fifteen minutes produc-

ing superficial anesthesia so that the application of the tourniquet may be painless. After the tourniquet is applied, the rubber inflatable ring is drawn over the leg proximal to the tourniquet and the entire extremity including the tourniquet and rubber ring is placed in the refrigeration box which has been filled about one-third with small pieces of ice. More ice is then placed in the box to cover the entire extremity. The lid is then fastened in place and the leg remains refrigerated for a period of two hours. The patient with the extremity enclosed in the box is then

transferred to the stretcher and brought to the operating room. The leg is removed from the box while being transferred from the stretcher to the operating table. The surgeon then proceeds with amputation, the tourniquet being removed prior to the closure of the wound in order to control hemostasis.

The operation, in our experience, has

been painless and has not required any supplementary anesthesia. I believe this has been the experience of Dr. Crossman in his larger series of cases. Less preoperative medication is necessary than is used for general anesthesia. It is also necessary that the leg be defrigrated slowly after the amputation by the use of ice bags to the stump for two to three days.



THE important problem in the induction of anesthesia by inhalation is to establish and maintain a free airway so that the anesthetic agent can enter the lungs, pass from the lungs into the blood stream, and by the blood be carried to the nervous system. It is often important to employ some device which will prevent the tongue and epiglottis from obstructing the space above the larynx.

# A NEW INSTRUMENT FOR USE IN BILIARY SURGERY

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THE retractor herewith illustrated was designed to give a maximum exposure of the biliary ducts with minimum effort on the part of the assistant. From the standpoint of the assistant, it is almost foolproof.

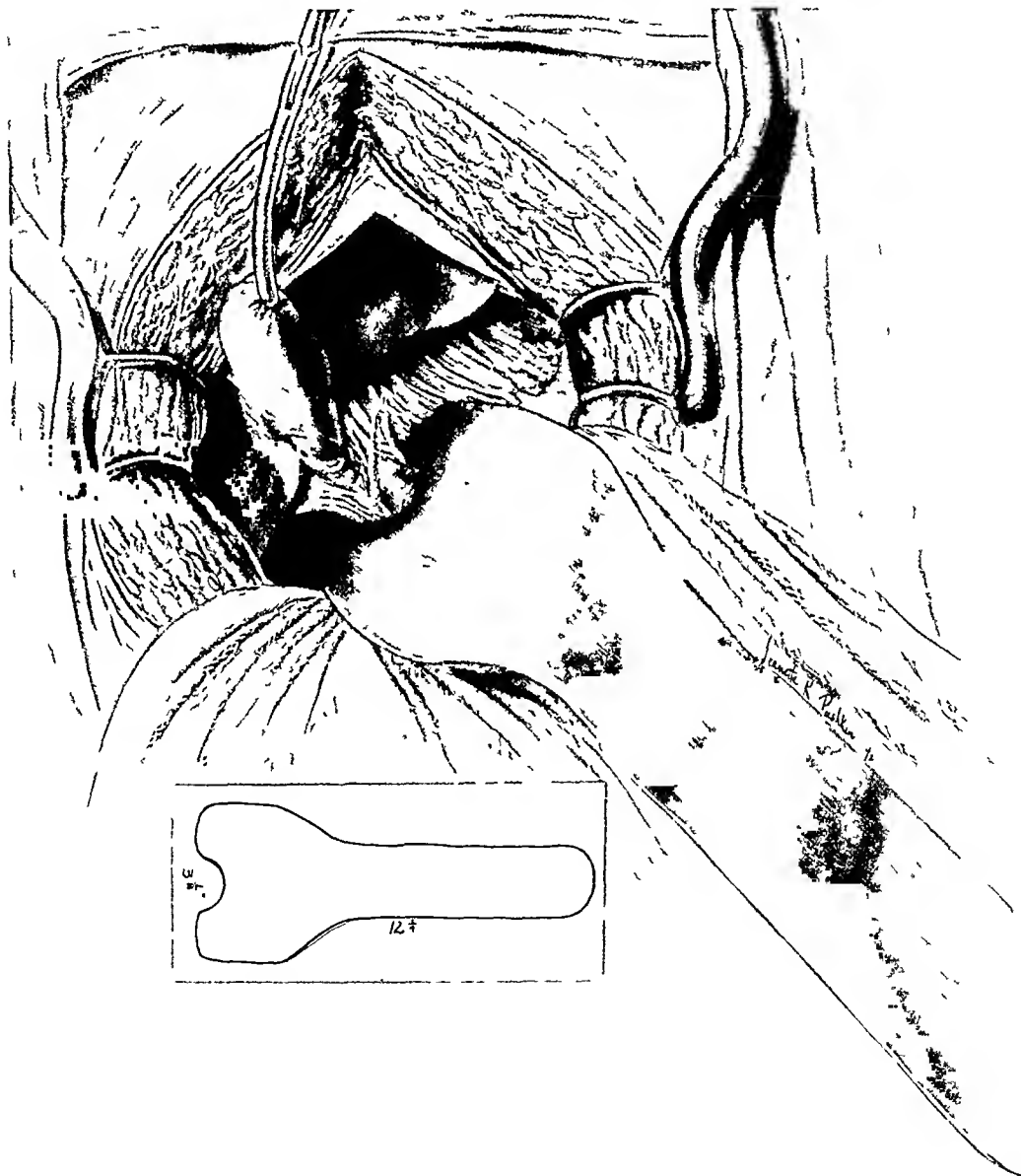


FIG. 1. Illustration demonstrating the use of this new retractor, with the notched end exposing the cystic and common bile ducts, portal vein and the hepatic artery.

\* Dr. R. H. Walker passed away on February 19, 1942, a few days after the receipt of this manuscript.

Before developing this retractor, it was my practice to use the assistant's left hand for retraction in exposure of the ducts. The hand took up considerable space and was constantly shifting. In addition, the left forearm and shoulder of the assistant were frequently in the way of the operator. These annoyances were removed by this specially designed instrument.

The retractor is made of the same mate-

rial as the so-called "ribbon retractors." It is, therefore, pliable and can be bent to adjust itself to any curve in securing exposure of the ducts. It is  $12\frac{1}{4}$  inches in length,  $3\frac{1}{8}$  inches wide at its broadest end and  $1\frac{3}{4}$  inches at the narrowest end. The broad end is notched so that the retractor may rest down over the ducts without injury to them, and at the same time secure the greatest possible amount of exposure.



DIAGNOSTIC block anesthesia usually is carried out for patients who complain of various disturbances, the most common of which is pain; it is also used when the pathway of the pain cannot be determined exactly, so that blocking of one or more pain pathways assists in establishment of the differential diagnosis.

The brief excerpts in this issue have been taken from "Clinical Anesthesia. A Manual of Clinical Anesthesiology" by John S. Lundy, W. B. Saunders Company.

# NEW ATRAUMATIC NEEDLE FOR FASCIA SUTURES

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THE value of fascia sutures, either living or preserved, in the repair of hernias and in bridging defects of the

simply and quickly. (2) The fascia suture can be easily drawn through tissues because the combined diameter of the neck and

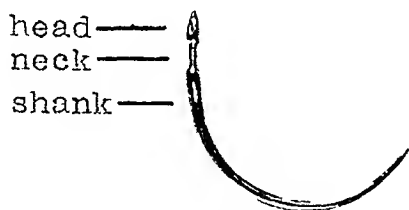


FIG. 1. Needle enlarged to show detail.

abdominal wall, is well known. Unfortunately, however, there has been restriction of the use of fascia, and often abandonment, because of trauma produced in suturing. Large needles and unwieldy methods of attaching the fascia to the needle cause splitting and fraying of the tissues, and thus may seriously weaken and endanger the repair.

A new and atraumatic needle is presented here to simplify the use of fascia and to lessen trauma. The unique principle is best indicated by Figure 1.

The needle is round, full-curved and has a taper point. The greatest diameter is in the shank at the junction with the neck. The neck obviously is much smaller and the head is a slight enlargement at the end of the neck, just large enough to prevent the fascia from slipping off.

The fascia is placed on the neck, long axis of the strip in the long axis of the needle, with the end of the strip at the junction of the neck and shank. It is bound around the neck with six or seven turns of tightly wound fine silk thread. (Fig. 2.) It has been shown that great pull will not dislodge the fascia strip.

The advantages of this needle may be listed as follows: (1) Attachment of the fascia strip to the needle is accomplished



FIG. 2. Atraumatic and eye-type needles compared in size and mode of attachment of fascia strip.

fascia is no greater than the largest diameter of the shank of the needle. Obstruction to passage by knotting of the fascial strip, as is necessary when eye type needles are used, is thus obviated. (3) This needle may be made considerably smaller than other needles used for this purpose because of the unique principle employed. (4) The entire length of the strip of fascia is conserved. No part of the length need be sacrificed to make a knot, as is the case when eye type needles are used; nor is there any loss because of fraying as may be the case with slot type needles. The silk thread binding the fascia to the neck is simply unwound or cut away to release the fascia from the needle.

# METAL STIRRUP FOR KNEE SUPPORT IN APPLYING A PLASTER CAST

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AS everyone applying plaster casts knows, support of the knee while putting on a hip spica is difficult. If

made of steel and the bottom of pipe. A ring at the top is for attaching a rope. The vertical arms are bent at a right angle to fit

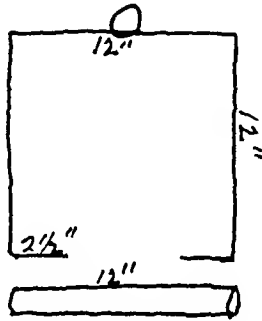


FIG. 1. Arms of the stirrup separated.

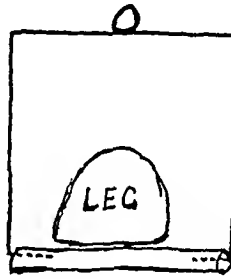


FIG. 2. Stirrup assembled; leg in position.

a bandage or a rope is used, it hugs the limb, is incorporated in the plaster; and, if removed, it comes away with difficulty. Moreover, plaster bandages cannot be readily passed between the arms of the loop.

To obviate this difficulty, I have devised a square metal stirrup, the top and sides

into the pipe. The leg, properly padded, rests on the bottom of the stirrup. Plaster bandages are easily passed through it. When the cast is firm, the arms are sprung from the pipe, which is now removed. The cast may be reinforced if necessary. One use of this stirrup will prove its value. It can be made by any mechanic.



# OPPONENS THUMB WIRE SPLINT

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THE efficiency of this opponens thumb splint has surpassed, in my experience, that of other types of braces thumb in opposition and partial abduction crosses the palm of the hand and terminates in an ulnar flange. In Figures 1A and

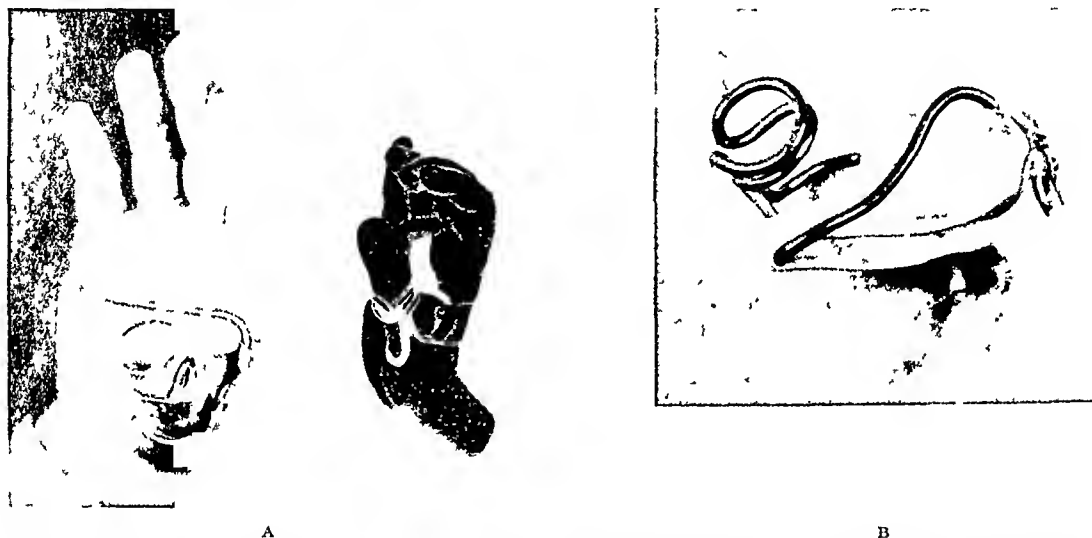


FIG. 1. The opponens thumb wire splint as utilized in cases wherein free wrist motion is permissible. It has proved very efficient in the treatment of the flat hand, illustrated on the right of (A), of a child with residual paralysis following acute anterior poliomyelitis.

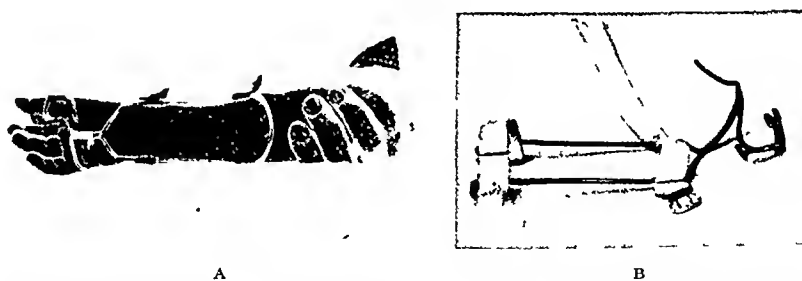


FIG. 2. The combined opponens thumb and cock-up wrist splint, constructed from one continuous piece of clothes-hanger wire, as utilized on the hand and forearm of a child with spastic hemiplegia.

employed in an effort to hold the thumb in its functional position. It is extremely light in weight and is constructed, in each instance, from one continuous piece of clothes-hanger wire. The wire that fixes the

1B the brace is held by a strap across the dorsum of the hand and permits free wrist motion, while in Figures 2A and 2B the brace has been incorporated in a cock-up splint.

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# SURGERY OF THE COMMON DUCT\*

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**P**ATHOLOGY in and about the common bile duct is one of the causes for the mortality and morbidity encountered in biliary tract surgery. There has been a general reduction in the mortality and morbidity following surgery of the gall-bladder for simple non-complicated gall-bladder disease. This has been achieved through a better understanding as well as a consideration of the secondary changes associated with cholecystic disease. The factors of common duct pathology have, however, received less attention, and therefore, surgery on the ducts has not advanced as rapidly as has surgery on the gall-bladder. Recent interest and investigation in the field of common duct pathology promises better end results.

TABLE I  
OPERATIONS FOR COMMON DUCT DISEASE

Operations	No. of Operations	No. of Deaths	Per Cent Mortality
Choledochostomy and cholecystectomy	327	40	12.2
Choledochostomy and cholecystostomy	25	9	36.1
Choledochostomy and cholecystectomy with a secondary operation	6	1	16.2
Choledochostomy secondary to a previous cholecystectomy	39	15	38.6
Cholecystogastrostomy (2 cholecystoduodenostomies)	52	15	28.8
Plastic on ducts	5	3	60.0
Total operations for duct pathology	454	83	18.2
Total biliary tract operations	3,986	309	7.7

This analysis of common duct surgery is an endeavor to determine some of the factors underlying the general high mortality and morbidity. The basis for this

study is a series of 454 consecutive cases of common duct disease in which operation was done at the New York Post-Graduate Hospital between 1920 and July 1, 1937. Table I summarizes the operations performed, the number of deaths in each and the mortality rate.

Table II is a résumé of the same cases grouped in accordance to their postoperative diagnosis.

TABLE II  
SURGERY ON THE BILE DUCTS POSTOPERATIVE DIAGNOSIS

	No. of Operations	No. of Deaths	Per Cent Mortality
Common duct stones			
And chronic cholecystitis	213	30	14.0
And acute cholecystitis	80	8	10.0
After cholecystectomy	33	12	36.4
Common duct disease without stones (dilated duct—cho- langitis, stenosis, etc.)			
And chronic cholecystitis	11	1	9.0
And acute cholecystitis	11	3	27.0
After cholecystectomy	6	3	50.0
Chronic pancreatitis			
And chronic cholecystitis	26	1	3.8
And normal gall-bladder	6	1	16.2
Acute pancreatitis (suppurative and hemorrhagic)			
And chronic cholecystitis	8	2	25.0
And acute cholecystitis	7	5	71.4
Severe operative injury of the common duct (complete de- struction of portion)	2	1	50.0
Carcinoma of the bile ducts	5	3	60.0
Carcinoma of the head of pan- creas	46	14	30.4
Total operations for duct pathology	454	83	18.2

The common duct pathology found in the series falls into two groups, i.e., those conditions intrinsic to the duct, and those extrinsic to it. The diseases intrinsic to the duct are found associated with a pre-

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existing cholecystic disease in a majority of instances.

#### INTRINSIC COMMON DUCT DISEASE

*Common Duct Stones.* This was by far the most common cause for surgery on the common duct. Choledochostomy was performed at the time of cholecystectomy or cholecystostomy for chronic disease in 260 instances and stones were found in 82 per cent. In 3,306 operations for chronic cholecystitis, the incidence of common duct surgery was 7.7 per cent and of stones 6.3 per cent.

The invariable pathologic finding was an associated severe cholecystitis. This advanced pathology of the gall-bladder found in common duct disease lends authority to the assumption that intrinsic common duct disease is usually secondary to gall-bladder disease. That cholecystitis is a progressive disease which eventually involves the common duct has been noted repeatedly in our series. Walters<sup>1</sup> recently stated that "generally speaking, infection, stone formation, and obstruction of the common duct can be directly or indirectly related to inflammation which takes its origin in the gall-bladder." Lahey<sup>2</sup> is definitely of the belief that common duct infection, stone formation, and obstruction are due to neglected cholecystic disease. Lahey and Swinton<sup>3</sup> found stones in the gall-bladders of 98 per cent of their common duct stone cases.

It is probable that the more frequent open exploration of the common duct in our cases would have demonstrated a higher incidence of stones. Allen,<sup>4</sup> in a review of 1,228 cases, found that the common duct was explored in 32 per cent of them. Furthermore, stones were present in 13 per cent of all his cases. Cheever<sup>5</sup> also explored the common duct more frequently and in 426 personally operated cases, he did a choledochostomy on 37.9 per cent, finding stones in 44.3 per cent of those explored.

It is evident that if common duct surgery is to be avoided, the patient with chronic

cholecystitis and cholelithiasis must come to surgery before the common duct has become involved. This means early diagnosis and early surgical intervention. In our series, the evidence of common duct stone and the mortality rate in operations

TABLE III  
DURATION OF CHOLECYSTIC SYMPTOMS IN COMMON DUCT STONE

Duration of Symptoms	Total Cases	Common Duct No. Cases	Per Cent Common Duct Stone
Under 2 years.....	1,270	24	1.9
2-10 years.....	1,020	92	9.0
10-35 years.....	610	97	16.0

on the common duct increased rapidly with the duration of the symptoms. (Table III.)

Delay in surgery is also a big factor in common duct stone associated with acute cholecystitis. In 574 operations for acute cholecystitis, eighty patients had common duct stones, an incidence of 14 per cent. In only three of these cases was there no history of previous cholecystic disease. Therefore 96 per cent had a definite chronic cholecystic disease history. Liedberg<sup>6</sup> found a similar incidence of common duct stones in 556 acute cases in which he operated. He believes that the common duct must be explored, if indicated in acute disease, in spite of the added risk, for often the common duct obstruction is the cause for the acute process.

Stones may be formed in the common duct after the removal of a pathologic gall-bladder. It is impossible to state how many of the thirty-three patients with the secondary common duct stone were of this type and in how many the stones had been overlooked at the previous operation. A number of the patients in this series were relatively symptom-free for three to ten years before they had recurrent symptoms. In six cases the common duct was literally filled with stones of the calcium bilirubinate type. Common duct stones were found in

80 per cent of all secondary common duct operations following cholecystectomy. This is in marked contrast to the report by Beye<sup>7</sup> in which only 6 or 9 per cent of sixty-six secondary operations showed common duct stones.

*Intrinsic Disease without Stone.* Stones were not found in thirteen cases of choledochostomy for chronic disease. These patients had a definite cholangitis, a stenosis of the common duct, or a marked spasm of the sphincter of Oddi. As in the stone cases, the gall-bladder showed severe pathology. Best and Hicken<sup>8</sup> believe dilatation of the common duct may result from persistent sphincter spasm. Walters<sup>1</sup> also is of this opinion.

A dilated common duct without evident pathology was found in eleven instances associated with an acute cholecystitis. In four cases the obstruction may have been due to a chronic pancreatitis. This was not confirmed. It is likely that cholangitis and stenosis were the causative factors.

In six cases of secondary choledochostomy stones were not found. Two of these had a severe cholangitis. The secondary operation followed shortly after a previous cholecystectomy. It is probable that the cholangitis was a residual infection of the preëxisting disease. Severe common duct stenosis was seen in three instances. This was due to operative injury. In two additional cases there were divided common ducts due to operative accidents.

*Carcinoma of the Bile Ducts.* Carcinoma was rare in this series. Only five proved cases came to operation. In three instances an excision of the cicatrix and duct anastomosis was attempted. One of the patients, at autopsy, showed a carcinoma of the ampulla of Vater. In the other two a high choledochostomy was done for temporary relief of icterus.

#### EXTRINSIC DISEASE OF THE COMMON DUCT

*Carcinoma of the Head of the Pancreas.* Carcinoma of the pancreas was the major cause for common duct surgery where the pathology lay extrinsic to the duct. Sixty-

two cases were so diagnosed at operation, and only forty-six of these had short-circuiting operations. Cholecystostomy alone was done on the remainder. Cholecystogastrostomy was done in forty-four cases and choledochoduodenostomy in two. The former was found to be highly satisfactory as a palliative measure. In the majority of the cases, operation was done when the disease was far advanced. The average icterus index was 114. Lahey,<sup>9</sup> in a recent publication, stated his belief that a sidetracking operation was of the greatest value. He, however, prefers a cholecystoenterostomy (jejunum) instead of the cholecystogastrostomy so generally used in our series. In none of the cases of this series was a resection of the head of the pancreas attempted. Best and Hicken<sup>10</sup> warn of the danger of a stenosis of the cystic duct in short-circuiting with the gall-bladder.

*Chronic Pancreatitis.* Chronic sclerosing pancreatitis is the second largest extrinsic cause of obstruction of the common duct. This condition was seen in thirty-six cases and contributes largely to those cases having a dilated common duct without other evidence of obstruction. These patients were, in the main, treated by choledochostomy. Again, a severe cholecystitis was usually associated with the pancreatitis. In four instances a fulminating acute cholecystitis was present with the chronic pancreatitis. Bergeret<sup>11</sup> found the incidence of chronic pancreatitis with common duct stone very high. He believes that the obstruction is the cause of pancreatitis.

Six cases of chronic pancreatitis were treated by means of a cholecystogastrostomy. In three a clinical diagnosis of carcinoma of the head of the pancreas had been made. In two this was disproved by a biopsy and in one at autopsy.

*Acute Pancreatitis.* Acute suppurative and hemorrhagic pancreatitis was present in fifteen cases, in eight associated with a chronic cholecystitis and in seven with an acute cholecystitis. The gall-bladder was

removed in each instance. Five of the acute cases were either gangrenous or perforated. Choledochostomy for acute pancreatitis is still a disputed procedure. Many operators practice drainage of the common duct in the presence of an associated cholecystitis. (Abell,<sup>12</sup> Dunlop and Hunt,<sup>13</sup> and Eliason and North.<sup>14</sup>)

#### DIAGNOSIS

The surgeon has three opportunities for diagnosing common duct disease: a *preoperative diagnosis*; a *careful exploration* at the operation; and a careful study during the *postoperative period*, before removal of the drainage tube.

*Preoperative Diagnosis.* Jaundice, colic, chills, and fever are no longer considered pathognomonic of common duct stone or obstruction. A careful evaluation of the history and physical findings of the cases presented in this series shows that only 60 per cent had two or more of these symptoms. Jaundice was the most consistent finding. The reason for the frequent absence of colic was demonstrated by MacDonald.<sup>15</sup> He showed that typical colic cannot come primarily from the common duct.

Repeated duodenal drainages are of immeasurable value in the differential diagnosis of common duct disease. Persistent organisms, particularly colon bacilli, crystals, and pus cells, if found in the presence of a diseased gall-bladder, are strongly indicative of common duct stone. Stones rarely completely obstruct the common duct. In complete obstruction there is usually an extrinsic cause. Lahey's modification of Courvoisier's law is particularly apt in the diagnosis of carcinoma of the head of the pancreas. He states that "in the presence of jaundice which is persistent, painless, and progressive, together with consistently acholic stools when the gall-bladder is palpable, the obstruction is in practically all cases due to carcinoma of the head of the pancreas."

*Diagnosis at the Time of Operation.* Thorough exploration of the bile ducts and

of the pancreas is an essential step in every operation on the biliary tract. Maingot,<sup>16</sup> MacDonald,<sup>15</sup> Walter,<sup>1</sup> Cattell,<sup>17</sup> Smyth and Mason,<sup>18</sup> and many others are advocating more frequent common duct exploration at the time of cholecystectomy. Nearly all agree that the common duct should be drained when once opened. Beall,<sup>19</sup> however, disagrees with this procedure. He believes that primary closure is the method of choice unless the obstruction cannot be removed. The use of cholangiography will materially reduce the hazard of overlooking common duct pathology.

The indications for exploring the common duct at operation are nicely summed up by Cutler and Zollinger.<sup>20</sup> They are (a) the suggestion of a stone on palpation, (b) a dilated or thickened duct, (c) a contracted gall-bladder, (d) a dilated cystic duct, (e) a thickening of the head of the pancreas, and (f) the presence of small stones in the gall-bladder or the cystic duct.

*Postoperative Diagnosis.* Every effort should be made to determine the function of the common duct before the drain is removed. Cholangiography will give the best index of the restoration of function of the common duct.

One of us (C. G. H.) has been employing the visualization of the common duct by the use of hippurin. The day before the test is to be made a preliminary injection of 20 to 30 c.c. of normal saline is injected through the T-tube. We have found that this amount will be taken with practically no discomfort. The quantity may be increased up to 40 c.c. with only some slight discomfort. The solution will run almost by the effect of gravity from the syringe into the common duct, and into the duodenum. On the following morning the patient is taken to the x-ray department and from 10 to 20 c.c. of sterile hippurin is injected slowly through the T-tube and an x-ray picture is taken immediately, a second picture four minutes and a third twelve minutes later. The first negative will show that both the right and left

hepatic ducts are well filled with the solution. There will be moderate distention of the common duct and, if the ampulla of Vater is unobstructed, the dye will be almost immediately present in the duodenum. In four minutes the dye will be in the duodenum and neighboring jejunal loops, and at the end of twelve minutes the third negative will show almost complete evacuation of the dye into the intestine.

The food test, as outlined by Carter,<sup>21</sup> is an excellent check on the function of the sphincter of Oddi. Careful microscopic and chemical examination of the bile from the common duct tube as well as the duodenal bile is of further help in assuring a normally functioning duct.

#### MORTALITY AND MORBIDITY

Of the 454 patients in this series, eighty-three died, a mortality of 18.2 per cent. Forty-six of the surviving patients had severe complications, potentially lethal. For the study of the mortality and morbidity, the series had been divided into four groups. They are (a) choledochostomy when combined with an operation for chronic cholecystitis; (b) choledochostomy when combined with an operation for acute cholecystitis; (c) choledochostomy secondary to a previous cholecystectomy; and (d) cholecystogastrostomy for obstruction of the lower common duct.

*Choledochostomy Associated with Chronic Cholecystitis.* Surgical drainage of the common duct was performed 254 times in the presence of chronic cholecystitis. The mortality was 13 per cent, a rate much higher than that reported by Eliason and Erb,<sup>22</sup> Allen,<sup>4</sup> Lahey,<sup>2</sup> and Cheever.<sup>5</sup> Table IV is a summary of the cause of death and the postoperative morbidity in this group. The common duct stone cases had generally far advanced cholecystic disease. These included twelve cases in which there was a chronically perforated gall-bladder. Six of these patients died. The mortality was primarily influenced by the age of the patient, the duration of the illness, and the severity of the infection.

Pneumonia leads as the cause of death. Pneumonia and cardiac failure were found predominantly in patients over 60 years of age. Peritonitis, the cause of death in seven cases, resulted from perforation of the gall-bladder in three instances and from acute pancreatitis in three. Those diagnosed as "liver death" died of the typical syndrome described by Heyd<sup>23</sup> in 1924.

Delay and deferred surgery in chronic cholecystitis and cholelithiasis is the primary cause for the high mortality and morbidity reported. The high incidence of pneumonia and cardiac failure in the aged, the number of perforations as well as the incidence of pancreatitis, and the large number of infections, all point to delay in operating.

*Choledochostomy Associated with Acute Cholecystitis.* Of the ninety-six patients in this series sixteen died, a mortality of 16.4 per cent. The incidence of common duct disease coexistent with acute cholecystitis was 17 per cent. Table V is a summary of the cause of death and the morbidity in this group. Most of the patients requiring common duct surgery in acute disease had a history of repeated attacks of colic or inflammation.

The major cause of death in this group was peritonitis, with pneumonia second in frequency. All but one of the deaths due

TABLE IV CHOLEDOCHOSTOMY AND CHRONIC CHOLECYSTITIS	
Cause of Death	Major Complications
Pneumonia..... 8	Wound infection..... 5
Peritonitis..... 7	Postoperative hemorrhage..... 5
Liver death..... 7	Pneumonia..... 3
Cardiac failure..... 5	Dehiscence..... 3
Postoperative hemorrhage..... 2	Thrombophlebitis..... 3
Uremia..... 2	Intraperitoneal infection 3
Pulmonary embolism... 2	
Coronary occlusion.... 1	

TABLE V CHOLEDOCHOSTOMY AND ACUTE CHOLECYSTITIS	
Cause of Death	Severe Complications
Peritonitis..... 7	Wound infection..... 4
Pneumonia..... 4	Pneumonia..... 2
Liver death..... 2	Peritonitis..... 3
Postoperative hemorrhage..... 1	Persistent fistula..... 1
Cardiac failure..... 1	
Coronary occlusion.... 1	

to peritonitis occurred in patients who had gangrenous or perforated gall-bladders complicating their common duct disease. Pneumonia was again seen in the aged.

The severe complications were due in the main to infection. In those patients with common duct disease and acute cholecystitis, where the process had not progressed to empyema, gangrene, or perforation, the mortality was 7.2 per cent. Delay in operating in chronic cholecystitis increased the incidence of acute cholecystitis and the incidence of common duct involvement; and delay in operating during an acute attack increased the severity of the acute pathology. These factors probably account for the mortality and morbidity in this group of patients.

*Secondary Choledochostomy.* Of the thirty-nine patients who underwent secondary choledochostomy, fifteen died, a mortality of 38.6 per cent. Table VI is a summary of the causes of death and the severe complications encountered in this group of patients. The mortality is identical with that experienced in most clinics. The high mortality rate in this group emphasizes the importance of discovering and treating common duct disease at the time of the primary operation.

*Cholecystogastrostomy.* Fifteen of the fifty-two patients in whom a cholecystogastrostomy or duodenostomy was done, died, a mortality of 28.8 per cent. Forty-six of these were for carcinoma of the head of the pancreas. The mortality in our series is that generally reported. Bernhard<sup>25</sup> reports a mortality of 29.8 per cent, Eliason and Erb<sup>22</sup> 38.4 per cent, Mayo-Robson<sup>26</sup> 53.3 per cent, and Kehr<sup>27</sup> 75 per cent. Best and Hicken<sup>10</sup> found a mortality of 41.1 per cent in 221 cases reported in the literature.

The average age of these patients (entire series) was 60 years. Table VII shows that pneumonia was the major cause of death, which was to be anticipated in the aged and debilitated patients. Only three deaths can be attributed to operative difficulty, two because of operative shock and one peritonitis. The death from hemorrhage

occurred in reoperation. No bleeding point was determined, the hemorrhage being general. The icteric index in this patient was 240 preoperatively.

TABLE VI

## SECONDARY CHOLEDOCHOSTOMY

Cause of Death		Severe Complications	
Peritonitis.....	5	Wound infections.....	2
Liver death.....	3	Pneumonia.....	1
Pneumonia.....	3	Peritonitis.....	1
Operative shock.....	2		
Cardiac failure.....	2		

TABLE VII

## CHOLECYSTOGASTROSTOMY

Cause of Death		Severe Complications	
Pneumonia.....	9	Hemorrhage.....	4
Liver death.....	2	Dehiscence.....	2
Operative shock.....	2		
Peritonitis.....	1		
Postoperative hemorrhage.....	1		

## CONCLUSIONS

1. Delay in operating on patients with chronic cholecystitis and cholelithiasis is the major cause for common duct disease.
2. Repeated acute attacks of cholecystitis predispose to acute common duct pathology.
3. The mortality and morbidity in surgery of the common duct are directly proportional to the duration of the symptoms, the age of the patient, and the severity of the associated cholecystic disease.
4. The common duct should be explored whenever any probable indication of disease is present.
5. Secondary choledochostomy carries a very high mortality. This high mortality justifies more frequent primary exploration.
6. The mortality of cholecystogastrostomy is due to the general condition of the patient, especially jaundice and the factor of malignancy. Earlier diagnosis and surgery can reduce this mortality.

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# PANCREATITIS AND BILIARY TRACT DISEASE\*

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A DEFINITE relationship between biliary tract disease and pancreatitis has long been recognized. Korte's<sup>1</sup> treatise in 1898 called attention to acute necrotic pancreatitis as associated with biliary tract disease. Fitz,<sup>2</sup> in 1889, first thought pancreatitis due to a "gastro-duodenitis," but later (1899) came to believe it due to a common duct lesion. Opie,<sup>3</sup> in 1901, showed acute necrotic pancreatitis to be due to a regurgitation of bile into the pancreatic ducts. His conclusions have been ably seconded by Archibald<sup>4</sup> and many others. This view has been generally held because of the frequent association of the two lesions (20 per cent to 50 per cent—Jones<sup>5</sup>). More recently the lymphatic origin of all types of pancreatitis has been indicated both experimentally and clinically. Graham and Peterman<sup>6</sup> have been outstanding advocates of this theory.

Regardless of the actual etiology of chronic and acute pancreatitis, biliary tract disease pathology is frequently found coëxistent with a pancreatitis and therefore its treatment enters into the surgical considerations to be weighed when pancreatitis is operated upon. Cullen and Friedenwald,<sup>7</sup> Takats and MacKenzie,<sup>8</sup> Babcock,<sup>9</sup> Dragstedt, Haymond, and Ellis,<sup>10</sup> Rich and Duff,<sup>11</sup> Elman,<sup>12</sup> Walters,<sup>13</sup> and Bergeret,<sup>14</sup> are but a few who have, in the recent literature discussed this relationship and have indicated that the surgical treatment must include drainage of the biliary tract as well as a direct attack on the pancreas.

We are presenting forty-seven cases of proved biliary tract disease with associated pancreatitis operated upon at the New York Post-Graduate Hospital from 1920

to July, 1937. These cases of pancreatitis were found as a part of a study of 3,986 operations for biliary tract disease. An additional six cases had common duct surgery done for chronic pancreatitis, but no evidence of biliary tract disease was noted.

Table I indicates the postoperative diagnosis in cases with pancreatitis with associated biliary tract disease.

## CHRONIC PANCREATITIS

Chronic pancreatitis was diagnosed in the presence of chronic cholecystic disease in thirty cases. Two-thirds of these had common duct stones. The operator found the common duct stone resting at, or impacted in, the ampulla of Vater in fifteen of these cases (75 per cent). This observation lends clinical evidence to the theory that regurgitation of bile into the pancreatic ducts may well play a rôle in the cause of the pancreatitis encountered in these cases. All but one of the patients with pancreatitis and biliary tract disease had a long standing history of cholecystic disease (average eleven years). The gall-bladder pathology was uniformly severe. Ulceration, fibrosis, hydrops, and chronic empyema were common pathologic findings. Nearly 50 per cent of these cases gave clinical histories and pathologic findings suggestive of previous acute cholecystitis.

The six cases with a normal gall-bladder are of considerable interest, for here the common duct obstruction was due to a pancreatitis without an existing common duct disease. These patients were treated by means of a cholecystogastrostomy. In three a diagnosis of carcinoma of the head of the pancreas was made at the time of operation. In two the diagnosis of carci-

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noma was disproved by biopsy and in the third by autopsy.

### ACUTE PANCREATITIS

Acute pancreatitis was found associated with definite cholecystitis in seventeen instances. In fifteen the clinical pathologic diagnosis was that of an acute hemorrhagic

TABLE I  
POSTOPERATIVE DIAGNOSIS OF FIFTY-THREE CASES  
OPERATED UPON FOR PANCREATITIS WITH BILIARY  
TRACT DISEASE

	No. of Cases	Deaths	Per Cent Mor- tality
Chronic pancreatitis			
With chronic cholecystitis...	10	1	10
With chronic cholecystitis and common duct stone...	20	1	5
Normal biliary tract.....	6	1	16.6
Total chronic pancreatitis....	36	3	8.3
Acute pancreatitis			
With chronic cholecystitis...	2	2	100
With chronic cholecystitis and common duct stone...	8	2	25
With acute cholecystitis.....	7	5	71
Total acute pancreatitis.....	17	9	53

or suppurative pancreatitis. Only two cases of acute interstitial pancreatitis were diagnosed. Chronic cholecystitis was seen in ten instances, associated with a common duct stone in eight instances. The past history of these cases was generally similar. All had a past history of chronic cholelithic symptoms of long duration with occasional jaundice (average thirteen years). The acute episode was sudden, dramatic, severe. They came to operation an average of fifty-two hours after the onset of acute symptoms.

The seven cases with acute cholecystitis and acute pancreatitis were particularly severe. Five had a gangrenous perforated gall-bladder complicating the fulminating pancreatitis. In each instance the patient had a history of chronic cholelithic symptoms. Stones were present in the gall-bladder or free in the peritoneal cavity in

each case and, in addition, common duct stones were found in five. The patients were operated upon on an average of 2.8 days after the onset of their acute attack and after having been observed in the hospital an average of sixteen hours.

### OPERATIVE PROCEDURE

Table II is a résumé of the operative procedures undertaken in the cases here reported.

Drainage of the common duct is essential in the treatment of acute and chronic pancreatitis if any evidence of obstruction is present. In the majority of cases this is best accomplished by means of a choledochostomy. (Table II.) Cholecystostomy was resorted to only six times, four in chronic and two in acute cases, with a very unfavorable mortality. Best and Hicken<sup>17</sup> warn of the danger of using the gall-bladder for draining the common duct unless the patency of the cystic duct has been established. Cholecystogastrostomy was successfully performed in five out of six cases where the obstruction was so severe as to make a choledochostomy of questionable efficacy. Care must be taken to differentiate a chronic pancreatitis from a carcinoma of

TABLE II  
RÉSUMÉ OF THE VARIOUS OPERATIVE PROCEDURES  
UNDERTAKEN FOR THE RELIEF OF PANCREATITIS

	No. of Cases	Deaths	Per Cent Mor- tality
For chronic pancreatitis			
Cholecystostomy.....	4	1	25
Cholecystectomy and do- cholestomy.....	26	1	3.8
Cholecystogastrostomy.....	6	1	16.6
Total chronic pancreatitis....	36	3	8.3
For acute pancreatitis			
Cholecystostomy.....	2	2	100
Cholecystectomy and do- cholestomy.....	15	7	47
Total acute pancreatitis.....	17	9	53.3

the head of the pancreas so that the more radical short-circuiting operation may be avoided.

Acute pancreatitis presents a therapeutic dilemma that necessitates the greatest care and judgment if the patient is to survive. The treatment in our series was uniform in spite of the fact that eight surgeons operated on these cases. In each instance the capsule of the pancreas was incised and multiple drains inserted. Then cholecystectomy and dochoostomy were performed except in the two instances of cholecystostomy.

The high incidence of common duct stone in both chronic and acute pancreatitis, the severe gall-bladder pathology generally found, and the long duration of the chronic history, all suggest delay in the treatment of the preëxisting chronic cholecystitis to be the fundamental cause for the pancreatitis encountered in this series. Takats and MacKenzie,<sup>8</sup> Cullen and Friedenwald,<sup>7</sup> Elman,<sup>12</sup> Pratt,<sup>18</sup> and Heyd<sup>19</sup> are among those who believe that the majority of cases of acute hemorrhagic and suppurative pancreatitis result from neglected cholecystic disease. Early diagnosis and surgical treatment should reduce the incidence of acute and chronic pancreatitis as well as the high mortality found in it.

#### MORTALITY

The mortality rate in chronic pancreatitis and chronic cholecystitis was 8.3 per cent. This was only slightly higher than that found in the general series of chronic cholecystic disease (6.4 per cent). The mortality rate for choledochostomy in the presence of a chronic pancreatitis was only 3.8 per cent, a markedly lower rate than that seen in the 238 choledochostomies done for all chronic causes (11.34 per cent).

In acute pancreatitis, however, the mortality rate is exceedingly high. In our series there was a general mortality rate of 53.3 per cent. Those cases with chronic cholecystitis had a mortality rate of 40 per cent and those with acute cholecystitis had one of 71 per cent. This high mortality is

that generally reported in the literature. From Table II it can be seen that where the common duct has been drained, the mortality rate is more favorable than in those cases with indirect drainage. This may be a factor in reducing the mortality in all types of pancreatitis.

Peritonitis is the predominant cause for this high mortality. Eleven of the twelve deaths seen in our series were due to peritonitis. Six of these were autopsied, thus proving this diagnosis. Only one death was attributable to liver death (hepatic insufficiency). As no autopsy was performed it may well have been due to a fulminating intraperitoneal infection.

#### SUMMARY

Fifty-three cases of chronic and acute pancreatitis on whom biliary tract surgery was performed have been discussed. Biliary tract disease was present in all but six of these. Common duct stone was found in 66 per cent of those with biliary tract disease and chronic pancreatitis and in 78 per cent of those with acute pancreatitis. The surgical treatment, in the vast majority of cases, involved a drainage of the common duct as well as a direct attack on the pancreas. The mortality rate in chronic pancreatitis is that inherent in surgery on the biliary tract, and the mortality rate in acute pancreatitis that found in severe peritonitis. Peritonitis was the predominant cause of death in all cases.

The prophylaxis of both chronic and acute pancreatitis lies in the early surgical treatment of the preëxisting biliary tract infection.

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